ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Vol. XXV. No. 17.

TABLE OF CONTENTS.

Engineering News of the Week.....389,394, 398, 408

Technical Articles:

The Proposed Forth & Clyde Ship Canal (*illustrated*)..... 390
Prevention of Water Waste at Detroit, Mich..... 390
Notes on English Railways (*illustrated*)..... 390
The New Explosives—Favier, Belilite and Roburite..... 391
The Comparative Merits of Various Systems of Car Lighting—II. (*illustrated*)..... 392
Water Motors: Cost of Running, and Economy..... 393
Electric Lamp Patents (*illustrated*)..... 394
An Enlarged Waterway Between the Great Lakes and the Atlantic Seaboard (*illustrated, concluded from p. 384*).. 395
The New Gunboats..... 396
The Monarch Spring Rail Frog (*illustrated*)..... 397
Improvement and Traffic of the Harbor of Montreal..... 397
An Interesting Bridge Accident (*illustrated*)..... 398
Block Signaling..... 398
Riveted Steel Pipes (*illustrated*)..... 404
The Equipment of Freight Cars with M. C. B. Automatic Couplers (*with inset*)..... 406
Eight-Wheel Locomotive, Southern Pacific Ry. (*illustrated*) 408

Personals, New Publications, Society Proceedings..... 399

Editorial Notes..... 400

ENGINEERING NEWS General Index—New York City Building Laws—Factors of Safety Proposed for Ties, Beams and Posts—Unloading Plant for Gravel Trains.

Editorial:

Why the Equipment of Freight Cars with Automatic Couplers Should be Hastened..... 401
The Area and Population of the Great Drainage Basins of the United States..... 402

Correspondence.....402, 403

Temple (Tex.) Stand-Pipe Failure: A Trestle Failure at Temple—The Pegram Truss—Railway Traffic Passing Clapham Junction, London (*illustrated*)—Proposed Leaning Tower for the Columbian Exposition (*illustrated*)—The Kipton Accident, L. S. & M. S. Ry. (*illustrated*).

Construction News.....409-412

Railways, City Transit, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewerage and Municipal, Electrical, Contracting, Proposals Open, Manufacturing and Technical.

THE GROSS AND NET EARNINGS OF RAILWAYS in the United States for the month of February and the first three months of 1891, as compared with those for the corresponding periods of 1890, according to the *Financial Chronicle*, are as follows:

	February. (118 roads.)		Jan'y 1 to Feb'y 28. (118 roads.)	
	1891.	1890.	1891.	1890.
Gross earn's	$45,317,064	$43,484,394	$95,191,776	$89,424,483
Oper. exp...	32,970,107	31,991,537	68,925,452	65,586,863
Net earn's	$12,346,957	$11,492,857	$26,266,324	$23,837,620

This is a gain for February of 4.21% in gross earnings, and of 7.21% in net earnings. The most noticeable feature of the figures is the relatively large increase in net compared with the increase in gross. This is almost wholly due to the decrease in operating expenses, which, owing to adverse circumstances, were very large last year for many roads. The gain in net is more generally distributed than it was for the month of January, although the increase for the Pacific and Coal roads alone is greater than the total increase. As regards the lines showing large gains, they are found chiefly in the Pacific systems, the Coal roads and the Southern roads. The increase per cent. for these three groups being respectively 51.80%, 25% and 9.31%. In the group first mentioned the Southern Pacific has increased its net $518,886; then follow the Canadian Pacific with $167,948 increase, the Union Pacific with $61,646 and the Northern Pacific with $50,741. In the Coal group the Central of New Jersey shows $116,221 gain, and the Philadelphia & Reading $115,691; this latter, however, being offset to the extent of $35,031 by a loss on the Coal & Iron Co. In the Southern group the roads having large gains are the Central of Georgia with $53,629, the Chespeake & Ohio with $47,329 and the Louisville, New Orleans & Texas with $43,626. Outside of the roads in these groups the only others distinguished for heavy gains are the Baltimore & Ohio, which has enlarged its net $136,676; the Illinois Central, which has added $124,014, and the Mexican National, which has added $51,561. Six roads show decreases of over $40,000 each; the Atchison system and the C., B. & Q. leading, with losses of $182,188 and $181,576 respectively.

THE COST OF STREET CLEANING IN NEW YORK CITY for the quarter ending March 31, according to the report of the Commissioner of Streets, was $451,300, an increase of $4,208 over the total amount spent for similar purposes during the entire year of 1890. In addition $13,134 were spent for repairs and supplies. The number of square yards swept was 249,259,698, or 14,424 miles of streets, an increase of 1,636 miles over the corresponding quarter of last year. The ashes and garbage collected amounted to 416,883 loads, an increase of 76,053 loads over the first quarter last year. The matter finally disposed of amounted to 540,110 loads, of which 229,256 loads were carried out to sea and dumped and 310,864 loads were used in filling in bulkheads and for other purposes. There were 43,353 loads of snow and ice removed, more by 14,206 loads than during the same period of 1890.

THE TEST OF THE SERVE RIBBED BOILER TUBES at the works of the Samuel L. Moore & Sons Co., Elizabeth, N. J., which has been in progress this week, has shown a large gain in capacity and economy by the use of the tubes. On the forced draft trials a pressure of ⅛-in. of water was used, and the boiler evaporated a third more water in a given time when fitted with the Serve tubes than when fitted with the plain tubes. With the plain tubes the pyrometer showed a temperature of the escaping gases exceeding 1,200°. With the Serve tubes the temperature did not exceed 740°. Further trials were made on April 23 and 24 to see how strong a draft would be required to bring the temperature of the escaping gases up to the temperature which they had with the plain tubes. A full account of the tests will be given in a following issue.

THE IMPROVEMENT OF THE COMMON ROADS of the country will be discussed at a meeting of persons interested in that subject, to be held at the house of the American Society of Civil Engineers, New York, on April 28, at 8 P. M. It is proposed to initiate a movement for restoring, improving and rebuilding the old highways along the Atlantic coast and the main routes of inland communication connecting with them.

THE FOLDING BRIDGE at Chicago, Ill., over the Chicago river at Weed St., was tested by Mr. A. W. COOK, City Engineer, April 18. It has two leaves, each revolving on a horizontal shaft at about the street level, and provided with counterweights. Each leaf is folded up by raising it at the middle. The clear opening is 62 ft. The bridge was built by Shailer & Schniglau, of Chicago, and we shall publish further particulars of it shortly.

THE OWNERSHIP OF THE PATENTS FOR PRODUCING ALUMINUM will apparently be soon settled. In the case of Pittsburg Reduction Co. vs., the Cowles Electric Smelting & Aluminum Co., Judge RICKS granted an order restraining the defendants from increasing their present output of pure aluminum or from selling it at a price below that at which it is offered by the complainants at the beginning of the suit. In this connection it should be noted that the price of the pure metal has been raised to $1.50 per lb. Possibly this is done in order that everyone using the Cowles metal may understand that the ownership of the patents is still in doubt, although the Pittsburg company is now legally recognized as having a strong case.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision, April 18, at Kipton, O., on the Lake Shore & Michigan Southern Ry. An eastbound fast mail ran into a passenger train which was just starting to pull onto a sidetrack to let the mail pass. Both engines, 3 mail cars and a baggage car were wrecked. Six persons were killed and 3 injured. Further particulars of this accident will be found in another column. The responsibility is put upon the engineer and conductor of the westbound express in trying to reach Kipton when they were behind time, the mail having right of way. On April 17 a careless switchtender at the block-signal station at the crossing of the Flint & Pere Marquette R. R. and Michigan Central R. R. at Bay City, Mich., turned a switch in front of a train which had right of way on the former line. The engine was derailed, but nobody was injured. A Mann boudoir car was derailed and thrown down a bank on the Alabama & Vicksburg R. R. near Brandon, Miss., April 16. It is stated that the accident was caused by defective track, and that the Railroad Commissioners will make an investigation on this account. On April 20 the engine-driver of a train on the Staten Island Rapid Transit Ry. ran past a danger signal and into an open drawbridge near Port Richmond. The engine went into the water, with the front of the smoking-car resting on the cab. Nobody was injured.

A LOCOMOTIVE BOILER explosion occurred on the Northern Pacific R. R., April 9, while the engine was hauling a freight train near Tacoma, Wash. Two men were injured. The coupling rod of a locomotive on the Charlotte, Columbia & Augusta R. R. broke while the engine was hauling a train near Lewiedale, S. C. The fireman was seriously injured.

SEVERAL TRESTLE ACCIDENTS are reported, the worst one occurring April 16, at Fallston, Md., on the Maryland Central Ry., when a freight train of 13 cars drawn by 3 engines went down. Three men were killed and 2 injured. The wreck caught fire and the trestle and several cars were burned. The trestle was 250 ft. long, 50 ft. high at places, and was built of white pine in 1883. The timber is said to have been decayed. A derailed freight car caused the wreck of a trestle and freight train at Palestine, O., on the Columbus & Cincinnati Midland R. R., April 19. A trestle on the Great Northern Ry., near Barnesville, Minn., was set on fire by the wreck of a freight train and destroyed April 14. An iron bridge near Yazoo City, Miss., was seriously injured by a derailed freight train April 16. A trestle on the Missouri Pacific Ry., near Falls City, Neb., gave way under a passenger train last week, and 5 persons were seriously injured. A trestle on the Gulf, Colorado & Santa Fé Ry., between Belton and Temple, Tex., was washed away April 15, and a freight train ran into the gap. Two men were killed. A number of bridges and trestles on the Kentucky Union R.R., in Breathitt Co., Ky., are said to have been burned this week by employees who could not get their pay. The road is a new one.

THE STEEL RAILWAY BRIDGE AT WINONA, MINN., is nearly completed. The bridge proper is 1,300 ft. long, and there are 1,400 ft. of pile trestle approaches. It will be used by the Green Bay, Winona & St. Paul, the Chicago, Burlington & Northern, and the Winona & Southwestern railways, and will cost about $400,000. The Union Bridge Co., of New York City, has the contract.

A PERMANENT EXHIBITION of the products of the Southern States, including New Mexico and Arizona, is to be established at Raleigh, N. C. It will be opened May 15, and a special exhibition will be held in October and November. Northern manufacturers are invited to exhibit their goods. Hon. J. T. PATRICK is Secretary, with offices at Raleigh, N. C.

THE NIAGARA FALLS WATER-POWER TUNNEL was definitely located by the board of engineers at a recent meeting held at the company's offices in Buffalo. It was decided that the portal should be 11½ ft. above the average water level of the lower river, and that from this point the tunnel should be carried on an up grade of 0.4 % (4 ft. per 1,000). The route, as first decided upon, was to run from a point 20 ft. below average water level of the lower river, with the same grade. The tunnel, according to the present course, will penetrate limestone rock mainly, with occasional layers of slate. A full description of the proposed work was given in ENGINEERING NEWS of Nov. 8 and 29, 1890.

AN EXAMINATION FOR ARCHITECTURAL DRAFTSMEN will be held by the Civil Service Commission in Washington, D. C., at 9 A. M., May 12, as noted in our advertising columns this week. The grades and salaries are as follows: Juniors, $3 per day; seniors experienced as assistant architects, $5 to $8; draftsmen for steam and hot-water fittings, $5; engineer draftsmen for iron and steel construction, $6 to $8. If many applications come from Boston, New York, Pittsburgh or Chicago, examinations will be held in those cities. The department is having difficulty in securing and retaining competent men owing to the small pay offered, but the office seems to be a good stepping-stone to much more desirable private engagements for those who show capacity in it.

The Proposed Forth & Clyde Ship Canal.

[FROM AN ENGLISH CORRESPONDENT.]

A new scheme has been brought forward for the construction of the Forth & Clyde Ship Canal, the object of which is to practically unite the Atlantic and the German oceans by means of a waterway, navigable by ocean-going steamers, through central Scotland. The total length of canal from Yoker, a point on the Clyde, a little below Glasgow, to Grangemouth, near the head of the estuary, above Leith and the Forth Bridge, would be slightly less than 30 miles. There is already, as in the case of the Manchester Ship Canal, a canal for barge traffic connecting the two estuaries and suggesting the suitability of the route as a highway for ocean traffic. It is proposed that the ship canal be 26 ft. deep and 100 ft. wide at the bottom, with a minimum surface width of 126 ft. The canal would, therefore, be of the same depth as the Manchester Ship Canal, but would be slightly narrower. For a considerable portion of the route the proposed ship canal would be a deepening of beds of the rivers Kelvin and Carron. The existing barge canal was opened in 1790, and for some years dividends of from 10% to 25% were paid. In 1867, however, the Caledonian Ry. Co. purchased the canal, and since that time the traffic has been mainly transferred to

Map of Scotland Showing Location of Proposed Forth & Clyde Ship Canal.

the railways. It is, however, a remarkable fact that the net profits per mile of navigation on the canals owned by railway companies are $105 in Ireland, $495 in England and $1,810 in Scotland. In the last-named country most of the revenue is derived from the Forth & Clyde barge canal. The promoters of the ship canal estimate the annual traffic at 10,000,000 tons.

Several projects for the construction of this ship canal have been advanced at different times, one dating as far back as the year 1723. The present plan, adopted by the provisional committee, provides for a summit level 95 ft. above ordnance datum. There would be 12 locks, six at the Clyde end with lifts of from 15 ft. to 16 ft.; five at the Forth end with similar lifts, and a tidal lock where the canal would join the low-water channel of the Forth. The length of the summit level would be 17½ miles, and the minimum clear headway of bridges over the canal would be 75 ft. Six public railways cross the line of the proposed canal, and in two cases it is intended to provide swing bridges. In addition to these, two private railways, which also cross the route, would likewise be arranged with swing bridges. With the exception of necessary diversions at one or two points, the existing barge canal would not be interfered with. It is estimated that an annual supply of 3,000,000,000 cu. ft. of water would be obtainable from the watershed, for the top level, or about 10,000,000 cu. ft. per day. The majority of vessels passing through the canal would, it is believed, be from 200 to 1,000 tons register; and it is estimated that the above water supply would be ample for a traffic of at least 6,000,000 net registered tons per annum. The construction of the canal would necessitate some heavy cutting, principally through sandstone, for two miles at the Clyde end. The total cost of all the works, including railway and other crossings, with a liberal allowance for reservoirs and contingencies, is estimated at $30,000,000.

From a commercial point of view, the proposed canal would afford greatly increased facilities for the trade of Glasgow, Paisley, Renfrew, Port Glasgow, Greenock, Ardrossan, Ayr, Dumbarton, Clydebank, Kirkintulloch, Denny, Falkirk, Grangemouth, Edinburgh, Leith, Stirling, Alloa, Dundee, Aberdeen, etc. Some of these towns are on the line of the canal, and have important engineering and other industries, and coal and mineral deposits. Other towns could be connected by canalized rivers, and the great ports would be put into communication with the coasts on the opposite sides of the country, and with Glasgow and Leith. The English Government is to be asked to guarantee a dividend of 2½ to 3% on the cost of the works.

The Prevention of Water Waste at Detroit, Mich.

In 1878 the average daily consumption of water per capita in Detroit was 105 galls. In 1888 it was 205 galls. The average daily consumption in 1878 was 11,906,146 galls., and in 1888, 39,397,716 galls. In the winter of 1889, on very cold days, the daily consumption rose to about 50,000,000 galls, or 259 galls. per capita. The city was dependent upon two 42-in. supply mains, the economical capacity of which was 20,000,000 galls. each. The management of the works was thus forced to reduce the consumption or lay a new supply main. The cost of a third 42-in. main, a new pumping-engine, engine-house and accessories was roughly estimated at $600,000, the annual interest charges on which would be, at 4%, $24,000. The increase in operating expenses which would follow an increase in supply capacity would have swelled the expense still further.

In face of the above facts the water commissioners, of whom Mr. J. S. FARRAND was then President, on March 6, 1889, adopted a resolution instructing Superintendent HENRY BRIDGE and Secretary L. N. CASE to use all reasonable and lawful means to prevent the rapidly increasing waste.

A force of 8 inspectors was immediately appointed, whose first work was to distribute to every consumer a circular stating concisely the problem before the water commissioners, and asking the people to join with, rather than oppose, the board in its efforts to reduce the waste. The effect of the circular was to rapidly decrease the consumption, so that in a few days it was nearly 2,000,000 galls. a day less than for the corresponding time a year before.

The next work of the inspectors was to examine all service pipes and openings therefrom. This resulted in the discovery and repair or discontinuance of 3,145 leaks and 394 running streams. Later, a second circular was issued, stating that during the next winter water would not be allowed to run to waste to prevent freezing, and warning consumers or property owners to have their plumbing repaired so this would not be necessary. It hardly needs to be added that this warning was not very generally heeded.

At the close of 1888 there were in Detroit but 48 meters and indicators in use against 31,821 services. During 1889, 194 meters were placed, making a total in use at the end of the year, after deducting those removed, of 204, against 37,725 taps.

In 1889, during a part of which, only, inspection was carried on, the total consumption, or pumpage, was decreased by 1,504.8 million gallons—more than 10%. For the 10 previous years the total yearly increase in consumption had averaged 1,033.4 million gallons, so the actual saving was 2,528.3 million gallons. This represents a saving of $8,017 in fuel alone, of which $5,155 is the actual decrease over the previous year and the remainder the average annual increase in cost of fuel. The total expense for the inspection and circulars was $4,310, and for meters and setting the same $10,921. Of course, the total cost of the meters should not be charged against one year. It should also be remembered that no allowance is made above for a saving in other pumping expenses than cost of fuel, and that without the introduction of inspection and meters an enlargement of the works would have been necessary. Without trying to strike a balance, it is evident that the efforts to prevent waste were highly satisfactory.

In 1890 the work of inspection was continued, 36,625 examinations of service pipes being made, 1,397 leaks found, 1,200 repaired, and 84 premises shut off. The number of leaks found in 1889 was 3,145—more than twice the number found in 1890.

OPERATIONS OF THE DETROIT WATER-WORKS FOR THREE YEARS.

	1890.	1889.	1888.
Population	214,122*	203,992	192,729
Dy. av. consumption, galls.	33,208,067	35,274,888	39,397,716
Dy. av. consumption, per cap	155	172	204
Dy. av. consumption metered	1,717,657	381,068	251,370
Per cent. total consumption metered	5⅛	1	⅝
Number of services	40,351	37,725	31,821
Number of meters and indicators	866	204	48
Per cent of service metered,	2⅛	½	⅛
Miles of mains	362	343	313
Number of hydrants	2,410	2,237	1,913
Revenue from water rates.	$387,878	$367,925	$344,315
Revenue from metered water	37,278	13,909	9,175
Per cent. revenue from metered water	9¾	3¾	2⅔
Annual operating expenses.	102,391	102,587	101,019

The operations of the Detroit works during the three years 1888, 1889 and 1890 are presented in the accompanying table, and afford a striking instance of the reduction of waste and its effects upon revenue and operating expenses. The consumption fell from 204 galls. in 1888 to 172 in 1889 and 155 in 1890. This was effected almost wholly by inspection, as the amount of metered water in the three years was 0.63, 1 and 5⅛% of the total consumption. The total consumption for 1890 was 2,259.2 million gallons less than in 1888, but the total revenue from consumers in 1890 was over $23,000 more than in 1888, while the expense of maintaining the works was only about $1,400 greater in the last than in the first year. Meanwhile, the bonded debt and interest charges had not been increased on account of new pumps and supply mains, as would have been necessary had inspection not been adopted. The average daily consumption for 1890 was 6,189,651 galls., or 15%, less than in 1888, while the number of taps increased from 31,821 in 1888 to 40,351 in 1890.

The table given above was taken, with slight changes for convenience, from Secretary CASE's part of the report of the Detroit Water Commissioners for 1890.

Notes on English Railways.

(*Continued from p. 382.*)

MANCHESTER, SHEFFIELD & LINCOLNSHIRE RY.

This road, like the Lancashire & Yorkshire Ry. (ENGINEERING NEWS, March 28), is an east and west line. It has a total length of 295 miles, and among the principal towns upon the system are Manchester, Liverpool, Sheffield, Grimsby, Macclesfield and Nottingham. This company is joint owner with the Great Northern Ry. Co. and the Midland Ry. Co., of the system known as the Cheshire Lines (121 miles), which is under the management of a joint committee. At present the company is very closely connected with the Great Northern Ry. in regard to train service, especially for the express service between Manchester and London, as noted in ENGINEERING NEWS, Feb. 7. An independent line to London is now projected, however; starting from Nottingham and connecting at Aylesbury, 90 miles south, with an extension of the Metropolitan Ry. by which access would be obtained into London where extensive terminals are proposed. The scheme will be vigorously opposed by the Great Northern Ry., as the new line would parallel it and be in close competition. In the hilly district between Sheffield and Manchester numerous dams and reservoirs for water power were noticed.

Track.—The track is of the standard English type, already described and illustrated. The rails are laid with square suspended joints, spliced with plain splice bars, and four button head bolts, the nuts and washers of which are on the outer side of the rails. The keys are on the inner side. A few supported joints were noticed. The ballast is of cinders and gravel, and is very dirty. In general it is level with the tops of the ties, and in some cases covers their

* Figures for population from Report of Water Commissioners for 1890; preliminary census returns gave 205,669.

ends. There are 12 ties to a rail length, and some of the older ties are deeply cut by the chairs. Longitudinal timbers are used on bridges. The switch rods are of gas pipe, with screw couplings. Some iron lattice signal posts are used. In some cuts there is a dwarf retaining wall at the foot of the slope and the ballast is retained by a vertical dry wall, so that the ditch cannot easily become choked. Near Woodhead there are two single track tunnels side by side for the double-track line. These tunnels are 3 miles long. The small country station of Woodhead, and the portals of the tunnels, have castellated towers, etc., with a view to architectural effect. Some long high masonry viaducts have iron handrails and no parapets. Ordinary rails for inside guardrails are used on these viaducts, and are extended well onto the embankment approaches. On the 64 miles between Manchester and Retford, where the line joins the Great Northern Ry., there are long grades of 1 in 120 to 1 in 140 (0.83 to 0.72 %), and between Manchester and Sheffield there are numerous sharp curves on these grades.

Locomotives.—The road has some very fine express engines, used for the fast trains between Grantham and Manchester, a run of 97½ miles, with one stop at Sheffield (ENGINEERING NEWS, Feb. 7). These are inside cylinder engines, with 4 coupled driving wheels and a four-wheel leadng truck. They are fitted with a jet for applying sand under the driving wheels, and with the vacuum automatic brake, applying a cast-iron brake shoe upon each driving and tender wheel. The coupling rods are of I section. One of these engines, brought out in 1890, is shown in Fig. 43. It is hard work pulling trains over the division from Sheffield to Manchester, and the engines throw sparks considerably on the heavy grades. The tenders are large, of the ordinary six-wheel type, and have generally a railing around the top of the coal space. Some of them have a weather-board at the front end. There is a gong on the outside of the tank, to which is attached the train communication cord. Another interesting class of passenger engine has outside cylinders, outside frames, a single pair of driving wheels and a single pair of leading and trailing wheels. One of these engines is shown in Fig. 44. The whistles give a harsh, ear-piercing screech. This was noticed on nearly all the lines, although the Midland Ry. uses a whistle of a somewhat deep tone. There is no approach, however, to the deep, mellow sound of the chime whistle in general use on American railways, The engines and tenders are painted a light bright green, of a bluer shade than those of the Great Northern Ry. The striping is of black and yellow, and the frames are a burnt umber. The dimensions of the two classes of passenger engines above referred to are as follows:

	Eight-wheel. Fig. 43.	Single driver. Fig. 44.
Cylinders	18 × 26 ins.	17½ × 26 ins.
Diam. driving wheels	6 ft. 9 ins.	7 ft. 6 ins.
" truck and carrying whls.	3 ft. 6 ins.	3 ft. 8 ins.
Diam. boiler	4 ft. 3 ins.	3 ft. 11 ins.
Boiler pressure, lbs	160	..
Tubes, number	233	195
" dia meter	1¾	1¾
" length	10 ft. 8 ins.	12 ft.
Heating surface; tubes, sq. ft.	1,179	1.05
" firebox "	99	87
" total "	1,278	1,144
Grate area; sq. ft.	18.85	17
Driving wheel base	8 ft. 7 ins.	.....
Total "	21 ft. 9 ins.	15 ft. 9 ins.
W'ght; truck or leadg. axle, lbs.	31,248	21,976
" driving axle, lbs.	36,960	39,312
" trailing axle "	34,832	28,656
" total "	103,040	90,944
Tank, U. S. galls.	3,696	3,600
Coal space, lbs.	8,960	.....

Rolling Stock.—On April 1, 1891, this company followed the example set some years ago by the Midland Ry. in abolishing the second class. In the subsequent revision of passenger rates it is stated that the first class fare is not to exceed 3 cts. per mile, At a meeting in January Sir EDWARD WATKIN, Chairman of the company, repeated a remark he had made at a meeting of the Metropolitan Ry. Co. (of which he is also Chairman) to the effect that it seemed as though there would eventually be but one class, "with perhaps a few saloons." The movement in this direction, however, is very slow. The change in traffic on this line is shown clearly in the following table:

	1871.	1889.
First class passengers	15½	5½
Second class "	26	3¾
Third class "	58½	91

This line, like a number of other English lines, follows the practice of "slipping" cars from fast trains, for stations at which the trains do not stop. The slip coupling has one side of the link hinged, and kept closed by a spring. When the train is approaching the station where the rear car is to be left, the guard pulls a cord which opens the link and allows it to fall clear of the hook. The slip car is stopped at the proper place by hand brakes. An apparatus tried on this road by means of which the vacuum brake could be made available on the car after being slipped, was described in ENGINEERING NEWS, Dec. 6, 1890. The road has some comfortable modern built cars, with cushions and padded backs to the seats in the third-class compartments. The outside of the cars is rubbed down and varnished, not painted. Passenger trains are fitted with the vacuum automatic brake. Some of the brake vans, or cabooses, for freight trains are carried on 2 four-wheel trucks.

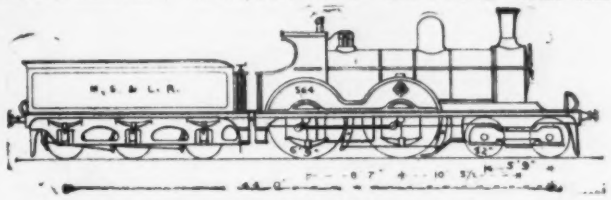


Fig. 43. Eight-wheel Passenger Engine.

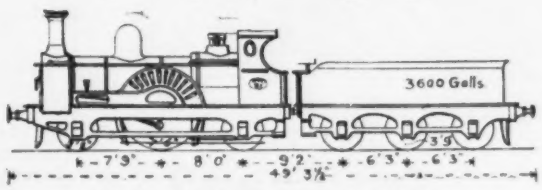


Fig. 44. Single Driver Passenger Engine.

LOCOMOTIVES, MANCHESTER, SHEFFIELD & LINCONSHIRE RAILWAY, ENGLAND.

The equipment of the Cheshire Lines includes some very long passenger cars, with trussed bodies on six-wheel trucks with iron frames and Mansell wheels. They are divided into 8 third-class compartments (80 passengers); 4 first, 2 second and 2 third-class compartments, or 6 third class and a baggage compartment. They are fitted with the brake above mentioned. The cars have the exterior varnished.

E. E. R. T.

(To be continued.)

The New Explosives, Favier, Bellite and Roburite.

Among the many explosive compounds invented in the last ten years, the Favier powders, bellite and roburite play quite an important part, says *Le Genie Civil*. These three compounds have been used quite extensively in mining operations, and chiefly recommend themselves for security in manufacture, transport and use.

The Favier explosives preserve the name of their inventor in France and Belgium, but they are called ammonites in England, and nitramites in other countries. The first patent dates from July 25, 1883. M. FAVIER was for a long time engaged in the manufacture of French dynamite, and in seeking to reduce the dangers inherent in nitroglycerine, he finally concluded that it was possible to make an explosive in which the nitrogen and carbon elements were simply placed together, but not combined. By means of a proper molecular shock, or concussions, the two elements could be made to unite in an explosive nitrogen compound, which would detonate immediately after formation.

In the fabrication of this explosive, M. FAVIER rested his formulas upon the two following principles: (1) It is possible to replace explosive nitrogen compounds, like fulmicotton and nitroglycerine, in which the nitrogen compound and hydrocarbon elements are united in one definite compound, by simple mixtures of these same elements. (2) By properly increasing the initial detonations, it is possible to detonate substances which are stable under ordinary conditions. Experience proves that certain stable substances are explosive under the influence of a sufficient molecular shock, without the necessity of first intimately mixing the nitro usually depended upon for detonation; in this case the nitrogen compound is a species of priming only.

The first application of these principles was made in Belgium in 1887. The first composition tried by M. FAVIER was the following:

Nitrate of ammonia	75
Dry resin	5
Charcoal	20
Intermediary detonator	5

The mixture of nitrate, resin and charcoal was forcibly compressed into a hollow cylinder, and the interior of this cylinder was then filled with dynamite *a la guhr*, forming the intermediate detonator. An ordinary capsule of fulminate acted upon the detonator, exploding first that and then the enveloping cylinder. It was found that while the fulminate alone would not explode the compressed mixture; if this mixture were crushed two grammes of fulminate would detonate it.

This fact and further investigations, led M. FAVIER to give his explosive the following definite form: The enveloping cartridge is made of nitrate of ammonia and nitronaphthaline in the proportions necessary to produce a gas at the moment of maximum oxidations. These proportions are approximately as follows:

Nitrate of ammonia	90
Nitronaphthaline	10

The intermediate detonator is the same mixture in a pulverized state. The nitronaphthaline is melted and incloses the nitrate; the hygrometric properties of the latter not permitting its use without this precaution.

The manufacture of this explosive is very simple. After having dried the nitrate by passing it slowly upon an Archimedean screw through a trough warmed by steam, it is pressed into a warmed former and sprinkled with the melted nitronaphthaline. In this manner a homogenous roll is formed, which is then carried to a graining machine with two cylinders. The grains are sifted; the finest are reserved for the intermediary detonator, and the others are molded warm into hollow cartridges under a light pressure. It will be understood that any considerable pressure would cause the hydrocarbon to exude, and the body of the cartridge would be made up exclusively of nitrate of ammonia, a substance extremely difficult to detonate. The cartridges are finally covered with paraffine; the detonator is put in, and the whole enveloped with paraffine paper.

The separate companies now operating under the patents of M. FAVIER, are as follows: In Belgium, *La Société des Explosifs Favier:* in France, *La Société Francais des Poudres de Sûreté;* in Spain, *La Société Espagnole des Nitramites,* and others in Germany, Austro-Hungary, Russia, and North and South America.

The Belgian factory of Vilvorde now makes two types for use in mines. The French factory at Saint-Denis make the five following explosions:

I.	*Grisounite,* detonating at 1480° C	nitrate of ammonia	95.5
		trinitronaphthaline	4.5
II.	*Grisounite,* detonating at 1785° C	nitrate of ammonia	92
		binitronaphthaline	8
III.	Poudre Favier, No. 1	nitrate of ammonia	87
		binitronaphthaline	12
IV.	" No. 2	nitrate of ammonia	44
		nitrate of soda	40
		bitritronaphthaline	16
V.	" No. 3	nitrate of soda	75
		mononitronaphthaline	25

The *grisounite* powders for use in seams and solid rock, are made in conformity with the rules of the ministerial circulars of July, 1890, for use in mines. In France, where the State has a monopoly of powders, the Favier powders are made in the national factories.

In these powders complete combustion is produced with the following proportions:

Nitrate of ammonia	90.85
Mononitronaphthaline	9.15

In a compressed state this mixture will not detonate in open air, and the detonation is still very difficul

when it is in a granular state. With an intermediary detonater of the pulverized mixture, a capsule of one gramme of fulminate will provoke explosion. The temperature of detonation is about 2120° C, according to Mm. SARRAU and VIEILLE; and the pressure developed per square centimetre is about 2,051 kilos.

The above proportion of the mononitronaphthaline has been definitely replaced by the mixture No. 3, because experience proved that it was often necessary in practice to use this powder in the open air, in breaking up soils, isolated blocks, ice, etc. The nitrate and the nitronaphthaline being stable substances, they can be manipulated with complete security, and their transport presents no danger. They are insensible to shock, fire and cold. Their excess of stability is their only fault, as this requires the use of 1 gramme of fulminate of mercury to explode a charge. On the other hand, the affinity for moisture, inherent in the nitrate of ammonia, which forms nine-tenths of the mixture, require great precaution in preserving it in stores or magazines.

Powder No. 3 seems to give the best results. As compared with dynamite, the Favier powders give out less flame, and are thus largely used in mines. They also emit a very little smoke, and this is absolutely inoffensive. The price is lower than dynamite, says *Le Genie Civil.*

The Comparative Merits of Various Systems of Car Lighting.

II.

PHOTOMETRIC INSTRUMENTS USED AND MANNER OF TESTING.

The instrument used in the photometric tests was the "radial photometer" of W. J. DIBDIN, F. I. C., F. C. S., Chemist to and Superintendent of the Gas and Gas Meter Testing Department, Metropolitan Board of Works, London, which is described in full in the *Journal* of the Society of Chemical Industry, Vol. III, page 277. The apparatus is shown in outline in Fig. 3. Mr. DIBDIN shows most clearly that

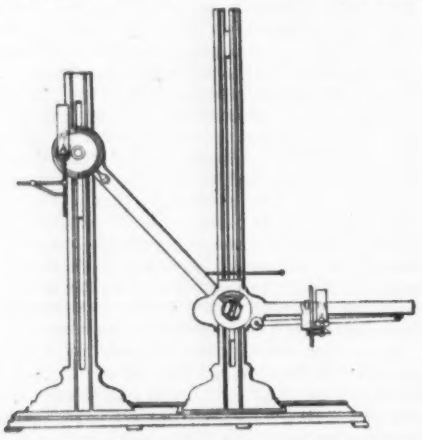


Fig. 3. Dibdin's Radial Photometric Apparatus.

the ordinary method of testing lights by horizontal measurements alone gives not only misleading but erroneous results. The value of the intensity of the emitted light in one direction, the horizontal, can only be of value when those rays alone are to be utilized in practice, and the results of such a test are useless, or worse, when the light is to be used at a point above or below the source of illumination.

The usual form of photometer is constructed to give the candle power in this horizontal direction only; but to really cover the required ground it is desirable to use the special instrument illustrated, or some equivalent. The principles upon which this instrument is constructed are as follows:

When two lights are opposed to each other in a horizontal direction, and a vertical screen is placed between them, it is evident that the rays impinging on them must do so in accordance with the well-known law of the squares of the distance. If the actual distance from the center of the screen remains constant while traveling through the circumference of a circle whose center is coincident with the center of the screen, the number of rays impinging upon a unit area of the disc must be less and continue to decrease as the position of the light is increased from that of the horizontal line; and this decrease is in exact ratio to the cosine of the angle formed by the position of the light with regard to the disc and the path of horizontal rays. Therefore the number of rays impinging upon the vertical disc will diminish with the cosine of the angle thus formed. The following diagram (Fig. 4) shows this clearly.

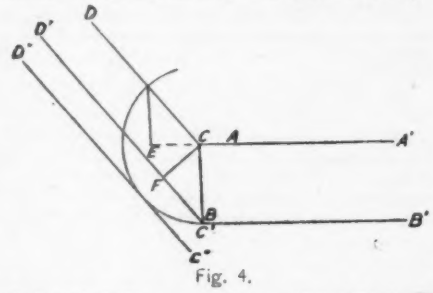


Fig. 4.

Let *A A'*, *B B* represent the section of horizontal rays impinging at right angles upon the vertical disc *C C*, and let *C D*, *C D'* represent the section of an equal number of rays thrown at a downward angle from a source of light placed above the horizontal. It is evident that the whole of the angular rays do not impinge upon the disc, *C C*, but that the rays that do so are defined by *C D*, *C D'*. By drawing the circumference of a circle whose radius is *C C*, and finding the cosine *C E*, it is at once seen that the section of the rays *C F* which impinge upon the disc is in exact proportion to the cosine of the angle of incidence, *C E*.

It is evident from the foregoing that the disc used must be arranged so that the angle of incidence be equal on either side, as outlined in Fig. 5, in which

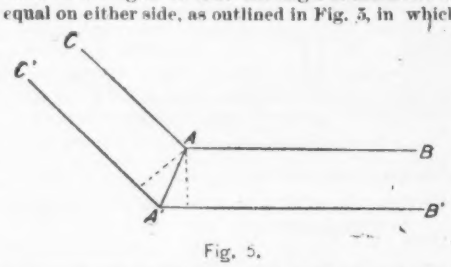


Fig. 5.

A A represents the disc, *A B* and *A' B'* the horizontal rays, and *C A*, *C' A'* the angular rays. With the disc arranged in this way it is evident that the loss of light by reflection is equalized.

The "radial photometer" of DIBDIN, as illustrated in Fig. 3, and which operates on this principle, consists of two vertical supports, one of which is permanently fixed to the baseboard or foot, while the one on the right hand travels on rollers on the baseboard in such a position that it will run in front of the fixed support. The two uprights are connected by a bar the ends of which work on axles attached to blocks which travel in the grooves of the uprights.

The centers of the axles correspond in position with the centers of the two graduated dial plates in front of the uprights. It is therefore evident that in whatever *position* the bar may be, the *distance* from the center of one dial to the other must be constant. In front of the dial plate on the traveling upright the screen or disc-holder is fixed so that its center is coincident with the center of the dial. The arrangement of the traveling standard on the graduated bar is evident from the sketch.

The disc used is the "star" or Leeson disc. This has been found to give the most exact readings with lights of slightly different colors. The arrangement of the screen to cut off extraneous light is not shown, but can easily be devised by the operator.

Standards.—The Methuen screen was used as a standard, carefully tested against standard candles before and after each day's work. The candle power of the standard was varied according to the lamp being tested, and was found to possess all the requirements of a practical standard.

The special plant used for measuring the consumption of illuminant by the Frost carbureter light is outlined in Fig. 6. This plant, as hereafter more fully shown, consists of a large "carbureter" of peculiar and ingenious construction, filled with wicking saturated with gasoline. This carbureter is placed on the roof of the car directly above the lamp, and through it a supply of air under slight pressure is driven to form the gas. Just before entering the carbureter the air passes through a coil just above the lamp, where it is heated, and thence it circulates through the carbureter and descends to the lamp beneath, charged with gasoline, where it is burned.*

In order to get the weight of the gasoline and amount of air consumed, the lamp and carbureter were attached to a platform, which was supported by four iron posts placed on a platform scale, which was accurate and sensitive to 1 oz.

The air supply came from the air tank through the usual regulation, and thence was measured by a new standard meter constructed so that, as is usual, the number of feet of air consumed per hour is indicated by readings of one minute. The actual readings were of longer duration, however, to secure greater accuracy.

The total weight of the apparatus before test was	235 lbs. 13 oz.
The weight at expiration of test was	225 lbs. 7 oz.
Amount of gasoline consumed	10 lbs. 6 oz.

This is equal to 1.92 galls. of gasoline of 88° B., or 0.65 sp. gr., which weighs 5.421 lbs. per gall. At 15

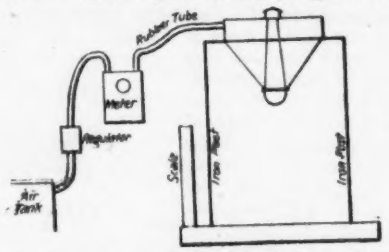


Fig. 6. Arrangement of Frost Carbureter Plant for Purposes of the Test.

cts. per gall. this amounts to 28.8 cts. for 41 hours burning, which indicates a cost per hour per lamp of 0.70 cts., to which, however, must be added further allowances for wastage, etc., as we shall see later.

The subjoined table shows in detail the consumption of air and gasoline for each hour of the test.

TABLE III.—DETAIL RECORD OF THE CONSUMPTION OF AIR AND GASOLINE OF A FROST CARBURETER.

FULLY CHARGED WITH GASOLINE, ACCORDING TO PRINTED INSTRUCTIONS, AND BURNED UNTIL EXHAUSTED.

[The summations given indicate the end of periods of continuous burning, which occupied parts of seven (7) different days. The double readings of air meter show the readings at beginning and end of the first hour.]

Hour.	Amt. of gas'l.	R'ad. of air m't'r.	Hour.	Amt. of gas'l.	R'ad. of air m't'r.	Hour.	Amt. of gas'l.	R'ad of air m't'r.
	oz.	cu.ft. per h.		oz.	cu.ft. per h.		oz.	cu.ft. per h.
1	5	1.7 / 1.7	16	4	1.9 / 1.5	31	4	4.0 / 3.0
2	5	1.4	17	4	1.7	32	4	2 4
3	4	1.	18	3	1.4	33	4	2.12
3h.	14	4.45	19	3	1.5	34	3	2.
			20	3	1.4	4h.	15	10.52
4	5	1.7 / 1.4	21	3	1.3			
5	5	1.	22	3	1.2	35	4	4.0 / 3.0
6	4	.75	7h.	23	10.35	36	4	2.8
7	4	.6	23	4	3.13 / 2.32	37	4	2.3
8	4	.5	24	4	1.84	38	4	2.3
9	3	.5	25	4	1.76	39	4	2.40
6h	25	5.35	26	4	1.56	40	3	2.41
			27	4	1.50	41	3	2.48
10	5	2.0 / 1.7	28	3	1.50	7h.	26	18.45
11	4	1.5	29	3	1.44			
12	4	1.4	30	3	1.44			
13	4	1.2	8h.	29	14.20			
14	3	1.1						
15	3	1.						
6h.	23	8.4						

SUMMARY.

Day of Test.	Hours of test.	Gasoline. Consumed.	Gasoline. Blown out.	Air consumed. Cu. ft.	Air consumed. Oz.	Gasoline per 100 p'rts air.
		Oz.	Oz.			%
First.	3	14	3	4.45	5.47	256
Second	6	25	3	5.35	6.58	380
Third.	6	23	2	8.40	10.33	222
Fourth.	7	23	1	10.35	11.73	181
Fifth.	8	29	1	14.20	17.47	166
Sixth.	4	15	1	10.52	12.95	116
Seventh.	7	26	..	18.45	22.69	114
Total	41	155	11	71.72	88.22	174

Total gasoline consumed.....166 oz. = 1.92 gallons.
Total gasoline which can be retained in air at 100° F ...40%

* The coil and the heating of the air supply have been abolished recently, as noted hereafter.

At the end of the forty-first hour the burner refused to work properly, flaring and smoking badly, and the test terminated. The total amount of gasoline used as illuminant was 166 oz., or 10 lbs. 6 oz. The amount of gasoline lost by blowing off was 11 oz., as follows:

Loss at the end of 3d	hour	burning	.....	3 ozs.
" " 9th	"	"	.....	3 "
" " 15th	"	"	.....	2 "
" " 22d	"	"	.....	1 "
" " 30th	"	"	.....	1 "
" " 34th	"	"	.....	1 "
				11 "

TABLE IV.—COMPARATIVE SUMMARY OF FIRST AND LAST HOURS OF EACH BURNING.
[Abstracted from Table III.]

DAY.	FIRST HOUR. Gasoline.	Air.		Gasoline per 100 parts of air.
	Oz.	Cu. ft.	Oz.	
First.....	5	1.7	2.09	239
Second.	5	1.55	1.91	262
Third.	5	1.85	2.28	219
Fourth.	4	1.70	2.09	191
Fifth.....	4	2.72	3.35	119
Sixth.	4	3.50	4.32	92½
Seventh	4	3.50	4.32	92½
Total.	31	...	20.30	152

DAY.	LAST HOUR. Gasoline.	Air.		Gasoline per 100 parts of air.
	Oz.	Cu. ft.	Oz.	
First.....	4	1.0	1.23	325
Second.	3.5	0.5	.62	563½
Third.....	3	1.9	1.23	244
Fourth.	3	1.2	1.48	203
Fifth.	3	1.41	1.78	169
Sixth.	3	2.0	2.46	122
Seventh....	3	2.48	3.06	98
Total.	22.5	....	11.80	189

To properly interpret and understand Tables III. and IV., some explanations and comments are needed, which we postpone till our next issue.

Water Motors: Cost of Running and their Economy in Connection with Water-Works Systems.*

Water motors are divided into two classes, one a jet, the other piston motors. All jet motors produce their effect by impact, by pressure, or by reaction, but never directly by the weight of the water. Hence they may be classified as impact, hydraulic pressure, or reaction wheels.

The impact wheels have radial or hollow arms on which the water acts more or less perpendicularly. The pressure wheels have curved buckets along which the water flows, and the reaction wheels have as their type a closed pipe from which the water discharges more or less tangentially. Pressure or impact, and reaction wheels are dissimilar to each other in construction. The essential difference between them being that in the two former the cells or conduits between two adjacent buckets are not filled up by the water flowing through them, while in reaction wheels the section is quite filled. If the buckets of an impact wheel are given great length and form a hollow curve, the water then not only impinges on the bucket but exerts a pressure on it, and the effect is claimed to be greater than in the purely impact wheel; the maximum effect is produced when the water falls dead from the wheel.

The theory of the reaction wheel is that the reaction is as great as the vertical impact of the water on a plane surface, and is claimed to be equal to the weight of a column of water, the basis of which is the area of the discharging orifice and whose height is double the height due to the velocity of the water discharged. The reaction wheel is more popularly known as the Barker wheel, and the most approved types are some form of what is known as the Scottish turbines. The outlets being generally two or three in number, made curved, with the introduction of a movable piece at the outer orifice of the conduits by which the section is regulated.

The other distinctive type of motor, the piston, is some form of a water cylinder engine, the motion being reciprocating rectilinear and not rotatory as in the jet or turbine, the leading feature being some form of a three-way cock, serving alternately to open and close the communication between the working cylinder and the pressure pipe. When the way is open the water presses on the piston and raises it with its load through a certain height, the length of the stroke; when the communication between the pressure pipe and the cylinder is shut, a way is opened for the discharge of the water from the cylinder and the piston descends by its own gravity. The piston water motors are generally made with a number of small cylinders, all connected to one central shaft and arranged so that when two or more cylinders are descending by gravity the others are doing work.

*Slightly abridged from a paper by Mr. S. E. BABCOCK of Little Falls, N. Y., read before the eleventh annual meeting of the American Water-Works Association at Philadelphia.

KINDS OF MOTORS.

The various types of water motors now on the market may be generally described as follows: The Tuerk water motor, manufactured at Chicago, is a sample of the jet motor, and is a combination of the impact and pressure wheel. Its economy is controlled by an automatic governor device. This device consists of a tapered or conical-pointed valve stem, accurately adjusted to fit on a ring nozzle, or bushing, by which the size of stream is increased or diminished in proportion as the point of the stem enters the bushing. This valve stem is made to enter into or recede in the bushing by the motion of the governor balls, being drawn in or thrown out as more or less water is required to perform the work.

The Backus motor, made at Newark, N. J., is another style of jet motor. It is claimed that the Backus should be called a pressure wheel, as it requires the impact and not the body of the water, and that it would run just as well with a jet of steam to drive it. This motor is also controlled by a governor and valve. Their controlling valve is, however, an angle valve located in the supply pipe and seems to have no immediate connection with or regulating the area of the jet. The valve raises off or lowers to its seat as various amounts of water may be required.

The Syracuse motor, made at Fulton, N. Y., is another form. It is a reaction wheel. It has a shaft with power projectiles. It is a form of Barker wheel, but is of a Scottish turbine type, the pipes or conduits, or, as they say, the power projectiles, are made curved and are two in number. The automatic governing feature is a moveable piece at the outer orifice of the conduits by which its sectional area is regulated, the centrifugal motion of the reaction conduits or projectiles automatically increasing or contracting the discharging orifices, as more or less speed, hence water, may be required.

The Pelton California motor, made at San Francisco, Cal., is an example of an impact wheel. This machine may be generally described as follows: It is an undershot wheel, hanging clear of the tail water. The buckets are pockets similar to grain elevator carriers, with a central septum or division, the jet being arranged with reference to the septum so as to divide the jet as it strikes the bucket or pocket. The wheel and bucket having received the impact of the water, the water falls away on each side of the moving wheel and the sides of the case are enlarged at this portion of its circumference so as to give a free exit to the water. The water is not carried along with the moving wheel scarcely any past the bottom center. The inlet water pipe enters at the base of the case. Provision is made for regulation by changing the tips of the jet. A hand-hole plate being provided on the side of the case to reach and change it. Three sizes of tips are furnished with each machine, and consumers are advised by the motor company to experiment with them. Using the smallest first and then the larger, if necessary, to give proper speed and power.

The Chandler & Silver water motor, made at Boston, Mass., is an example of the piston or water cylinder engine. It consists of five cylinders connected together in one solid casting, and rotating upon one central shaft or axis, being arranged in such a manner that the flow of water is admitted in a continuous stream to one cylinder after another, where it impinges directly upon pistons working in said cylinders, and by means of connecting rods imparts a continuous rotary motion to a wheel set at right angles to the cylinder shaft. The valve motion is so adjusted that not less than two cylinders are always open to receive the water pressure, thus avoiding any dead center. The automatic controlling arrangement is a counterbalance to the thrust of the pistons, arranged with a lever or weight on the side of the engine by which the stroke of the piston, and hence the quantity of water, is adjusted to the amount of work to be performed.

The Amherst motor, made at Holyoke, Mass., is also a piston or water cylinder engine. The peculiarity of its construction consists in 8 pistons, working very similarly to the Chandler & Silver, but with no regulating device.

The Belknap motor, made at Portland, Me., is an example of a reaction wheel. The regulating device is a positive contraction and expansion of the discharge ends of the two arms by a piston gear. This gear is extended to the outside of the motor to be operated, by lever, thus adjusting the water jets which are opened and closed at will by operating the two wedges, which are affixed securely to the end of the lever, which is operated by cog gears. The claim is that the water wheel runs very closely to the water chute, through which the water passing over wedges described, enters the wheel at a distance not exceeding ½ in., the water exerts its full force on the wheel nearer the orifice than of any other moter.

There are also a number of other motors made but not so generally advertised as those I have described. One is made at Oneida, N. Y., another in Binghamton, N. Y., one at Newport, N. Y., and one by Mr. Jas. Nailer, Jr., of Poughkeepsie, N. Y., and from what I can learn all these are either impact, pressure or reaction wheels.

Mr. BABCOCK next defined the horse power of water, and stated that the larger water turbines, used under low heads, produce from 60% to 85% of the nominal horse power, and the small water motors from 40% to 60%, dependent upon their construction. He added that their economy in practical every-day use is largely dependent on the sensitiveness of the adjustments by which the quantity of water used is adapted to the varying load or power required.

WATER MOTORS AT LITTLE FALLS.

I propose now to give a general statement of motors used, for what purpose, and the quantity of metered water for the year, in each establishment at Little Falls, N. Y., following up the same with a detailed statement of the amount of water used per minute by various machines operated by water motors and obtained by tests, hoping that this detailed information will form a more reliable basis than the simple statement of the total amount of water used for the year, as it has seemed to me that the metered water per minute required to operate a certain make and size of printing press, for instance, will form a reliable basis upon which to establish a probable consumption in any other locality. The head, or pressure, being given at the locality of the test, the variation in the amount of water used with a different head will be approximately proportional to the variation in the head. The lesser head requires more water.

D. H. Burrell & Co., Jobbers in Cheese Factory Supplies.—Water pressure, 120 lbs. 15 HP., Tuerk motor, used for operating a 1-ton elevator and for buzz saw 12 ins. in diameter. Consumption, Jan. 1, 1890, to Jan. 1, 1891, 341,210 cu. ft., or 2,552,250 galls., costing 3 cts per 1,000 galls., or $76.56 per annum. Metered water also used for drinking purposes and sprinkling street.

Journal & Courier Printing Office.—They have for the past year printed their weekly paper, and, in addition, the *Daily Herald* newspaper, as well as conducted an extensive job office. Water pressure, 110 lbs.; 8 HP. Tuerk motor, running one Campbell cylinder, No. 2 Complete press, and three Gordon platen job presses. ⅛, ¼ and ½ medium, respectively.

The Tuerk Motor took the place of an 8 HP. engine and boiler, costing, with attendance, $2 per day to run, or $600 per year. Consumption of water, Jan. 1, 1890, to Jan. 1, 1891, 426,910 cu. ft., or 3,193,286 galls., meter measurement, costing at 3 cts. per 1,000 galls., $95.79 per annum. This annual cost also includes water used for the general uses of a printing establishment, washing type, etc., as well as 5 water closets and two urinals, domestic water for two families and Masonic Knight Templar rooms, all passing through meter.

Dr. J. V. Hemstreet, Dental Establishment.—Two operating dentists, as also laboratory employees. Water pressure, 90 lbs. One HP. Tuerk motor, running lathes and other required machinery in a first-class dental establishment. Consumption of water, Jan. 1, 1890, to Jan. 1, 1891, 11,522 cu. ft., or 86,184 galls., meter measurement, costing at 3 cts. per 1,000 galls., $2.58 per annum. Metered water used exclusively for machinery.

W. R. Chapple, Herkimer County News.—This is a weekly newspaper and extensive job office. Water pressure, 105 lbs. Four HP. Amherst piston motor, running one Campbell cylinder No. 3 complete press and two platen job presses; also one Peerless Jobber, ⅛ medium, one Peerless Jobber, ⅛ medium. The motor took the place of a 5 HP. engine and boiler, costing $1 per day, or $300 per year. Consumption of water, Jan. 1, 1890, to Jan. 1, 1891, 145,338 cu. ft., or 1,087,128 galls., meter measurement, costing at 3 cts. per 1,000 galls., or $32.61 per annum. This amount also includes water for general uses.

J. S. Barnet & Bro., Calfskin Tannery.—This is probably the largest and most complete calfskin tannery in the United States. Water pressure, 140 lbs.; 15 HP. Tuerk motor in use, operates a dirt extractor, exhaust fan machine for drying hair and a hair washing machine, doing the work of steam, costing $5 per day, or $1,500 per annum. Consumption of water from Jan. 1, 1890, to Jan. 1, 1891, 1,998,900 cu. ft., or 14,952,445 galls. meter measurement, costing at Little Falls rates $449 per annum.

In this case the water, after having been measured and used in the motor, is passed along to the vats and again used for general tanning purposes.

F. L. Silltman, Tea and Coffee Store.—Water pressure, 95 lbs.; 2 HP. Syracuse motor, used for grinding coffee in a No. 18½ Enterprise coffee mill, Philadelphia make. Metered water not used for any other purpose. Consumption from Jan. 1, 1890, to Jan. 1, 1891, 44,296 cu. ft., or 331,334 galls., costing, at 3 cts. per 1,000 galls., $9 93 per annum.

F. Francisco, Bakery.—Water pressure, 110 lbs.; used for ice cream freezer with a capacity of 10 galls.; 2 HP. Tuerk motor. Consumption from Jan. 1, 1890, to Jan. 1,

1891, 16,347 cu. ft., or 122,275 galls., costing, at 3 cts. per 1,000 galls., $3.66 per annum.

Jno. R. Baker, Restaurant and Ice Cream Saloon.—Water pressure, 110 lbs.; used for a 7 gall. ice cream freezer and to operate 5 fans of the Kulp, Lancaster, Pa., make; 3 HP. Tuerk motor. Consumption, Jan. 1, 1890, to Jan. 1, 1891, 164,251 cu. ft., or 1,228,597 galls., costing $36.81 per annum. This consumption includes restaurant and bar uses.

Carden Brothers.—Water pressure, 120 lbs., 1 H. P. Amherst motor. Soda water and pop bottling establishment, one large Mathew's generator and fountain, size No. 151, two fountains. Consumption Jan. 1, 1890, to Jan. 1, 1891, 32,081 cu. ft. or 239,965 galls., costing at 3 cts. per 1,000 galls., $7.19 per annum. This also includes water used for washing purposes.

D. H. Burrell's Residence.—Pressure, 90 lbs.; 6 HP., California Felton motor, used for running dynamo, operating 24 16-candle power electric lights. Consumption not determined by meter measurement, as the price for electric light water power is fixed by the Little Falls rates at $20 per annum for 24 16-candle power lamps.

TEST MEASUREMENTS.

The test measurements show that the one-ton elevator in D. H. Burrell & Co.'s establishment requires the following amount of water to operate; 2,000-lb. load, raised and lowered, requires 50 cu. ft. up and 10 cu. ft. down; 1,000-lb. load takes 33 cu. ft. up and 20 cu. ft. down; 500-lb. load requires 28 cu. ft. up and 22 cu. ft. down. Elevator light, with one man on, uses 25 cu. ft. up and 22 cu. ft. down. The buzz saw uses from 13 to 16 cu. ft. per minute sawing, the variation being due to different thicknesses of wood sawed. All of the above loads were run 55 ft. vertically, up and down.

From the tests made in the *Journal and Courier* office I find that the No. 2 Campbell complete press requires 3.33 cu. ft. of water per minute to operate: the half-medium Gordon job press, 2 cu. ft. per minute; the quarter-medium Gordon job press, 1.66 cu. ft. per minute; the eighth-medium Gordon job press, 1.25 cu. ft. per minute. When the presses, all four, are running at the same time they use 4.44 cu. ft. per minute, and the three Gordon job presses only, running together, require 2.8 cu. ft. to operate. The advantage of an automatic regulation is apparent from the amounts of water used.

The No. 3 Campbell complete printing press in W. R. Chapple's *Herkimer County News* office requires 4.8 cu. ft. per minute to operate, and 4.5 cu. ft. per minute running light, no forms on. The platen job presses in W. R. Chapple's office require as follows; The half-medium Peerless, 3 cu. ft. per minute; the eighth-medium Peerless, 3 cu. ft. per minute; both job presses running together, 3 cu. ft. per minute; the Campbell No. 3 and the two Peerless presses running together, 5.05 cu. ft. per minute. These results show the loss due to the lack of a governing device.

The lathe in Dr. Hemstreet's dental rooms requires ½ cu. ft. per minute to operate.

The coffee mill in F. L. Silliman's store, which is an Enterprise, No. 18½, requires 1 cu. ft. per minute to operate it.

The washing machine in Barnett's tannery requires 8 cu. ft. per minute. The whizzer or drying machine requires 6 cu. ft. per minute to run, and both machines running together, 10 cu. ft. per minute.

The generator in the soda and pop bottling establishment of Carden Brothers requires 1 cu. ft. per minute.

The 10-gall ice cream freezer in Francisco's store requires 2.5 cu. ft. to operate.

It is but fair to state that in the case of Dr. Hemstreet's and the Silliman motors the supply main is too small, both being taken off of a single ¾-in. service. May 1, 1891, this will be remedied by changing to a 4-in. service and adding then to the same service the *Daily Times*, with a new Cottrell.

ECONOMIC FEATURES.

The economic features of the use of water motors comprises more factors then simply the saving, as compared to the cost of steam and its necessary attendance. There is the constant availability of a water motor under full capacity at any minute, the immediate stoppage of all running expenses when the particular work in hand is completed. Take, for instance, a printing press in the ordinary newspaper or job office. Presses are rarely run constantly during the hours of work, but usually represent but a fraction of the time each day and at no exact recurring or particular time of day. The motor, however, is always ready at full capacity. It is like a water-works system with hydrants, always ready at full fire pressure, as compared to the delays incident to getting up steam in the ordinary steam fire engine. There is also the immunity from danger from fire, hence less hazardous fire risk; the superior cleanliness as compared with steam; the absence of an intolerant heat in working rooms during the summer season, besides many other little conveniences incident to the use of water motors in place of steam. All these factors, however, may be said to inure to the benefit of the consumer, and not particularly to a water-works plant.

Let us now glance at the economic, or perhaps more exactly, the benefits derived by the water-works plant, incident to the introduction of water motors. From my test measurements made of the actual consumption of water, I am satisfied that it is not desirable to connect water motors where the working pressure is less than 50 to 60 lbs. per sq. in. When either a public or private plant is taxed up to near its full capacity for domestic consumption, and an additional supply is expensive to procure, motors are out of the question, but when the pressure exceeds 50 to 60 lbs., and there is a surplus in excess of domestic uses, either in quantity of water by gravity systems, or capacity of machinery in pumping plants, water motors may be made a profitable adjunct at water rates as low as 3 cts. per 1,000 galls. When rates up to 10 cts. per 1,000 galls. or upwards, are obtainable, all the receipts exceeding 2 or 2½ cts. per 1.000 galls. are profit. The actual cost of pumping and repairs of pumping machinery, it seems to me, should represent the cost to the water-works or company, not the addenda of fixed charges added. The fixed charges, interest, etc., accrue in any event whether more or less water is consumed. Any increased use of water paying any excess over and above the cost of pumping and repairs is just so much additional revenue that would not accrue unless the consumption was augmented either by water motors or other uses not provided for, or prospective in domestic consumption. The fixed charges, however, accrue whether such water motors are inaugurated or not.

Aside from the economic features already mentioned, Mr. Babcock called attention to the fact that the use of water motors makes possible the carrying on of industries in localities where it would otherwise be impossible, thus increasing the value of property and the population.

CONNECTIONS.

The paper closed with the following considerations regarding the making of service connections for water motors:

There is one detail of construction that I desire to call attention to, and that is, not to use too small a feed pipe or lateral service from the main. My experience tells me never to use less than a 2-in. lateral service in any case, and with all the larger sizes of motors to use a 4-in. cast-iron service. The 4-in. service does not necessitate a special in the mains, but the following plan will fill the bill: Plug the end of the 4-in. service, lay the plugged end on top of distribution main, carry three or four 1-in. taps by short lengths of 1-in. lead pipe from main to service, spacing the inch taps 15 ins. apart. This will prevent any undue weakening of main. The 2-in. service I lay the same way, using two 1-in. taps and short lengths of 1-in. lead connections. There is also an advantage in this plan, in that it takes up pretty much all the ram, if any occurs, banging away at the plug in the end, and does not affect the main.

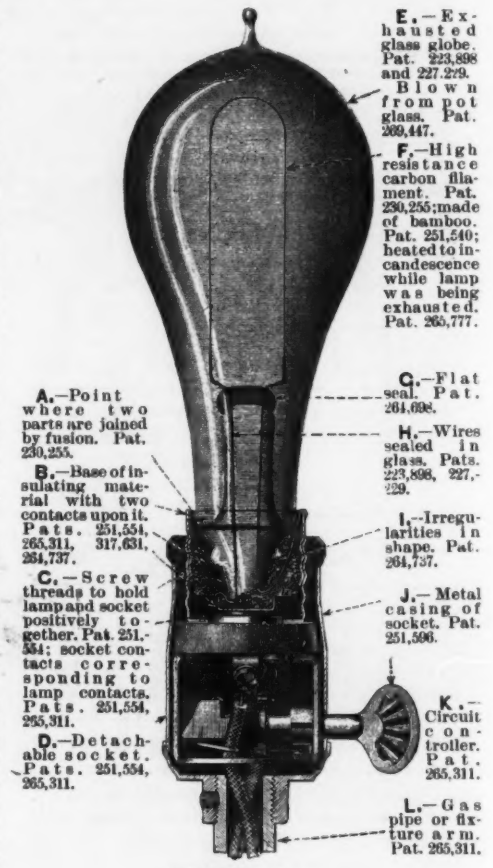
Electric Lamp Patents.

When it is remembered that the first strictly incandescent lamp was invented as long ago as 1841 by FREDERICK DE MOLYENS, of Cheltenham, England, it is certainly remarkable to note how many things there are about a lamp that are still covered by patents. The Sawyer-Man Co. makes a lamp which is covered by patents issued to WESTON, FARMER, MAXIM, SAWYER, THOMPSON, MAN and STANLEY. The Brush Electric Co. uses the lamp invented and patented by J. W. SWAN of England, the Thomson-Houston Co. has a lamp that has many patented features, and the United Edison Manufacturing Co. manufactures the lamp shown in the accompanying cuts with its patented parts indicated.

The history of this lamp, especially of the carbons, is very interesting, and is characteristic of the perseverance and energy that has marked EDISON'S rise from a train-boy to the most famous living electrician. EDISON'S first lamps were formed of fine platinum wire, coiled closely around a metal rod, which prevented fusion by expanding and breaking the circuit when the temperature rose too high. The wire was coiled because it would become incandescent only in that shape; when stretched out it would simply rise to a red heat. These lamps were very costly, owing to the platinum in them, and were soon destroyed by oxidation.

SAWYER and MAN proposed to remedy this oxidation by filling the glass bulb with nitrogen. Although their first experiments were successful, they finally failed to make this plan commercially useful. EDISON tried to obtain a vacuum in his bulbs, and, after adopting the mercurial air pump, was able to produce a lamp much like that now employed, save that the light came from an incandescent platinum wire. But platinum wire was plainly out of question for a cheap lamp, and in 1879, EDISON took out a patent for a carbon made from brown paper, which was too easily broken. In 1880 he patented the bamboo carbon that is now used.

The filaments from the interior of the bamboo are placed in air-tight nickel molds and carbonized at a high temperature. After being attached to their platinum supports, they are introduced into the glass bulbs, and, while the mercurial pump is removing the air, a fluctuating current of electricity of gradually increasing strength is sent through them. In this way all occluded gases are driven from the globe and carbon, and the whole lamp is subjected to a more severe test than it will ever practically meet.


E.—Exhausted glass globe. Pat. 223,898 and 227,229.
Blown from pot glass. Pat. 269,447.
F.—High resistance carbon filament. Pat. 230,255; made of bamboo. Pat. 251,540; heated to incandescence while lamp was being exhausted. Pat. 265,777.
A.—Point where two parts are joined by fusion. Pat. 230,255.
G.—Flat seal. Pat. 264,698.
H.—Wires sealed in glass. Pats. 223,898, 227,229.
B.—Base of insulating material with two contacts upon it. Pats. 251,554, 265,311, 317,631, 264,737.
I.—Irregularities in shape. Pat. 264,737.
C.—Screw threads to hold lamp and socket positively together. Pat. 251,554; socket contacts corresponding to lamp contacts. Pats. 251,554, 265,311.
J.—Metal casing of socket. Pat. 251,596.
D.—Detachable socket. Pats. 251,554, 265,311.
K.—Circuit controller. Pat. 265,311.
L.—Gas pipe or fixture arm. Pat. 265,311.

The Edison Lamp.

Every other detail of the lamp has been worked out with the same care as the carbon, and, although every point is patented, it should be remembered that a 16 c. p. lamp of the form shown in the cut can now be bought for 44 cts.

AN AUTOMATIC BRAKE AND COUPLER LAW has been enacted in Nebraska. It compels the equipment with automatic couplers of all new cars and all cars sent to shop for general repairs. After Jan. 1, 1895; it will be unlawful to use in the State any cars not equipped with automatic couplers. All locomotives must be equipped with driver brakes by May 1, 1892, and after Jan. 1, 1895, all freight trains must have enough air-brake cars to control the train.

THE IMPORTANCE OF USING THE INTERLOCKING PLANT, and all its minute precautions, is well illustrated by a murder case at Brooklyn, N. Y., this week, when the switchman in the Kensington tower of the Prospect Park & Coney Island R. R. was murdered at his post in the very act of shifting the signals to start a train. Not getting the starting signal the trainmen went to the tower to ascertain the reason, and found the switchman dead, having been shot through the back of his head. He had made all the necessary movements of the levers except the last one, which would have lowered the starting signal. The switch tower is in a lonely situation. The murderer has not been found, nor is the reason of the act known, as only the switchman's watch was taken, his money being left.

An Enlarged Water-Way Between the Great Lakes and the Atlantic Seaboard

(*Concluded from page* 384.)

PROJECTS FOR BETTER WATER-WAYS.

It is necessary now, with these general facts in mind, to take up the physical features of the present and projected routes, and ascertain whether it is practicable to develop, within a reasonable cost, a commercial route between the Great Lakes and the Atlantic seaboard. Any one who traces the very interesting history of the improvement of the water-ways up to this time, and studies only casually the history of commerce on the Great Lakes, will be led quickly and inevitably to a conclusion that the opinion outlined in the beginning of this paper is correct, that a channel large enough for vessels of a draught of 20 ft., the cargoes of which will average not less than 3,000 tons weight, is absolutely necessary. The various projects, with their estimates following, are based on these requirements. The "Soo" Canal and lock, now being built by the United States Government is fully equal to these requirements. The canal being built by the Canadian Government is not equal to them. To construct a lock costing, with its approaches, several millions of dollars for a draft of only 18 ft., is, in the opinion of the author, unwise.

OTTAWA SHIP CANAL BETWEEN GEORGIAN BAY AND MONTREAL.

In 1858 a report was made on this project by Mr. WALTER SHANLY, Civil Engineer, to the Legislative Assembly of Canada. The route lay from Lake Huron up the French River to Lake Nippissing, thence across the watershed of the St Lawrence and Ottawa into Trout Lake at the head of the River Matawan, a tributary of the Ottawa River, thence down the Matawan to the Ottawa River, and along its course to its mouth, thence by the Lachine Canal to Montreal. The supply for the summit level was to be taken from Lake Nipissing, which was to be raised by dams to the height of the small adjacent Trout Lake, 23 ft. higher than its natural level. At the rapids along this route dams were to be built and locks placed to overcome the difference of level. The French River, like the tributaries of the Ottawa and the Ottawa River also, were to be made navigable by these dams and locks. The summit would require a canal 5 miles in length with a maximum cut of 30 ft. through granite rock, and would be 93 ft. above Lake Huron. The lockage from the summit level down to Montreal was 615 ft., a total of 698 ft. The total distance from Georgian Bay to Montreal is 430 miles.

His estimate for the entire work was $24,000,000; depth on miter sills, 10 ft. While his plan contemplated throughout dams across the streams, wherever necessary to overcome rapids, his general principle was to build canals rather than to resort to high and expensive dams across the rivers.

In 1860 a second report on this project was made by Mr. T. C. CLARKE to the Commissioner of Public Works. Mr. CLARKE'S estimate was about one-half that of Mr. SHANLY'S, being $12,057,080. His plan, however, was much different from Mr. SHANLY'S, resorting still more to making as long reaches of slack water navigation as was possible, thus avoiding to a great extent the excavation through very hard and refractory rock which would be required by Mr. SHANLY'S project. On the other hand, Mr. SHANLY preferred to cut canals at the sides of rapids rather than to raise the levels of large rivers like the Ottawa by artificial structures. There was also a large difference in the price of rock excavation, Mr. CLARKE estimating it generally at an average of about $2.00 and Mr. SHANLY at $4.00 per cu. yd. Mr. SHANLY also estimated the cost for enlarging the Lachine Canal, 8¼ miles in length, near Montreal, which Mr. CLARKE did not; but on the other hand Mr. CLARKE estimated for a canal 12 feet on the miter sills. Mr. SHANLY estimated that the difference in cost between a 10-ft. and a 12-ft. canal must not be less than $5,000,000, making his estimate for a 12-ft. canal $29,000,000. It is difficult to explain the difference in the estimates. It is unnecessary to go into the details of the plans and estimates of these two projects, except so far as it is necessary to use the very complete details given in Mr. CLARKE'S report for making an estimate for such an enlarged water-way as this paper contemplates.

For the purposes of comparison, it should be stated that Mr. CLARKE'S plan contemplated locks 250 ft. long, 45 ft. wide, and 12 ft. depth on the miter sills, with a depth of 13 ft. in the canals, widths in bottom of short sections 100 ft., and in long sections 146 ft., where it was intended for boats to pass, with a depth of 15 ft. in the slack-water reaches A plan for the enlarged water way proposed by the author is as follows: Locks 600 ft. long, 85 ft. wide, and 20 ft. deep on the miter sills. The depth of canal prism 22 ft., with a width of 150 ft. in short sections and 200 ft. in the long sections, and with 24 ft. depth in the rivers and in slack-water reaches. Employing the data given in Mr. CLARK'S report, which appears to be accurate and quite complete, but using prices for rock excavation about midway between his and those of Mr. SHANLY, and allowing for the many new obstacles which the enlarged water-way would meet in the deepening of rivers and of locks where submarine rock excavation would be required, in either of the earlier plans, the total cost of the work would be about $83,000,000, allowing for the enlargement of the Lachine Canal to the dimensions of the enlarged water-way. A careful examination leads to the inevitable conclusion that a free unrestricted water-way cannot be found on the line of the Ottawa route at any cost which the traffic would bear.

GEORGIAN BAY AND TORONTO SHIP CANAL, OR ITS ALTERNATIVE, THE HURONTARIO SHIP RAILWAY.

A project for a ship canal was initiated on this route as early as 1846, and an examination made by Mr. KIVAS TULLY, Civil Engineer, of Toronto. In 1851 and in 1855 further examinations were made under the auspices of the Board of Trade of Toronto.

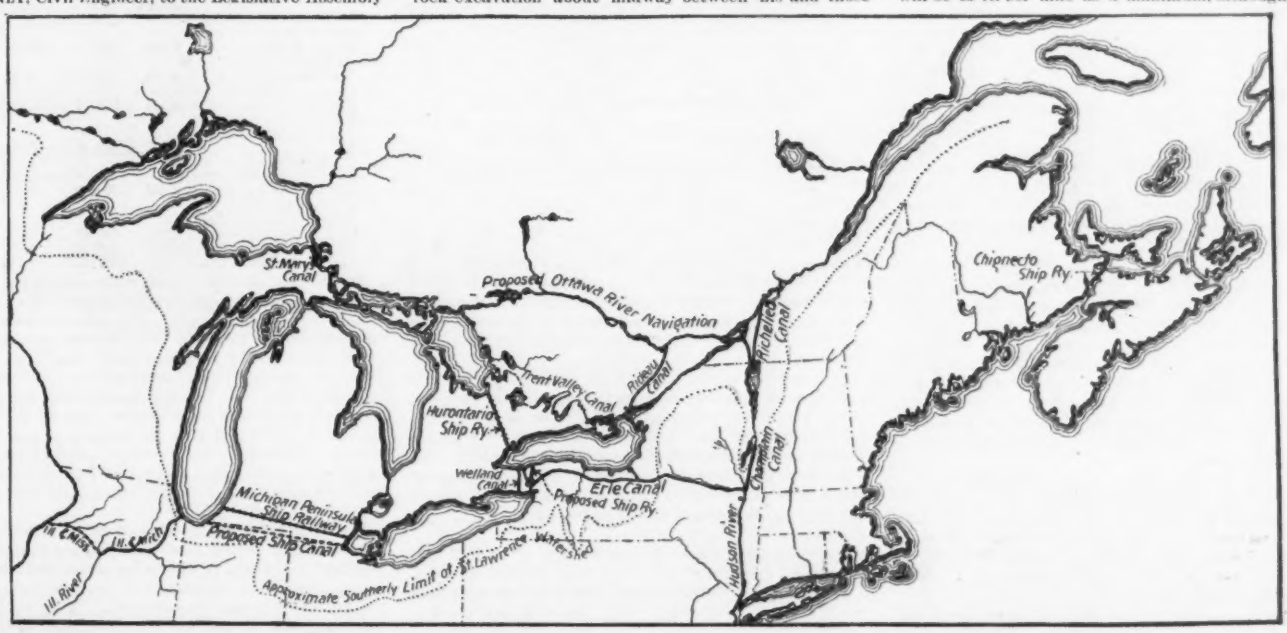
There was associated with him as consulting engineer Col. R. B. MASON, of Chicago, who himself examined the route in 1855. The survey was completed in 1858 and published with maps and profiles. The estimate was $22,170,150. The length of the route, which was by way of Lake Simcoe, was 100 miles, with 50 locks 265 ft. in length, 55 ft. in width, 12 ft. lift, with 12 ft. on the miter sills. Almost insuperable difficulties in the way of excavation were found at the summit, where for 10 miles there was a continuous cutting, the greatest depth of which was 197 ft., and the average cutting 90 ft. A company was, however, incorporated in 1856 for carrying out the project. Its charter was amended in 1865 under the name of the Huron & Ontario Ship Canal Co.

In 1881, when the late Mr. JAMES B. EADS was engaged in the project of a ship railway across the American Isthmus in Mexico, he was requested by Mr. TULLY, the Hon. D. BLAIN, of Toronto, and others associated with them, to give an opinion as to the feasibility of building a ship railway between Georgian Bay and Lake Ontario. His opinion was that it was not only entirely practicable, but that the route furnished one of the most favorable locations for such a construction, as the alignment was good and the grades low. This opinion was given in 1885 after three or four years of consideration at various times by Mr. EADS.

The length of the route is 66 miles. There were to be three railway tracks of the standard gage, with rails 110 lbs. per yd. It was intended to transport vessels of 1,000 tons, or, say, 2,000 tons displacement weight, and 14 ft. draft. The estimated cost was $12,000,000.

The author was at that time associated with Mr. EADS, and familiar with the data and the discussions of the subject. In order to present it now in connection with other projects for an enlarged water-way, he has considered it important to re-examine the subject, and to have a personal examination of the country made by one of his associates, in order to supplement data already in existence, and to reform the estimates on the basis of a ship railway of larger capacity than was contemplated by Mr. EADS; that is, for vessels of a displacement weight of 5,000 tons, with a draft of 20 ft., and the railway to be capable of transporting, during the navigation season, 8,000,000 tons of traffic.

It is impracticable, except at great cost, to build the railway on a straight line between the two terminal points. There will necessarily be in the central part of the route 2, and perhaps 3, deflection tables for changing the direction. The grades, as ascertained from all available data, will be 33 ft. per mile as a maximum, although on the larger part of the route the grades will be 11 ft. and 14 ft. per mile. The summit to be surmounted is 670 ft. above the mean level of Lake Ontario.



MAP SHOWING NAVIGATION ROUTES BETWEEN THE GREAT LAKES AND THE ATLANTIC SEABOARD.

The streets, public roads and railways to be crossed can all be easily provided for. The material to be moved is entirely earth, no rock being found on the route. The harbor improvements at the termini will not be expensive. The cost of the railway, fully equipped for the kind and extent of the traffic contemplated, is estimated at $15,459,318.

In reference to the physical features of the two routes the advantages are altogether in favor of the ship railway. The material to be removed on the Ottawa route is almost entirely rock and of granitic quality, being syenite and gneiss; these rocks, according to Mr. SHANLY'S report, "thrusting themselves forward harsh, naked and repellant, over the whole of the more distant portions of the line." . . . "On the nearer sections from the Chats Rapids to St. Ann, the formation to be dealt with, though of less impracticable character than that named above, is still rock—rock everywhere. The rock on the western part of the line is Laurentian, the very hardest that can be found. Insurmountable obstacles exist, such as the flooding of the country around Lake Nippissing. At the time Mr. SHANLY and Mr. CLARKE made their reports this was an almost uninhabited country. Since then along the northern part of the lake, which would be the shore to be submerged, there is now the main line of the Canadian Pacific Ry., and there are several towns and settlements and an improved country over nearly the entire area. It is questionable whether the plan proposed in 1860 could be carried out in 1890. Again," the fluctuation of 12 ft. in the level of the Ottawa River (being 24 ft. at the city of Ottawa) is a serious objection

to canalizing this route. Again, the examinations show that to obtain a depth such as is proposed by the present enlarged water-way, submarine excavations in hard rock must be made at various points in rivers and lakes not necessary for the depths proposed in 1860.

Another disadvantage of the Ottawa route is the difference between it and the Hurontario route in the opening and closing of the navigation seasons, a different latitude making the navigation season nearly a month shorter than by the Toronto route.

Another important difference is the difference in time of construction. The Hurontario Ship Ry. could be built within three years, and no doubt, if the government of Canada would make the necessary appropriations, the St. Lawrence canals between Lake Ontario and Montreal could be enlarged within 5 years, while it would probably require 10 years time to build an enlarged water-way along the Ottawa route, and it is not improbable that 15 years would be required for this work.

ENLARGEMENT OF WELLAND CANAL.

It has cost to enlarge the Welland Canal, from about 10 to 14 ft., $16,000,000. The estimate for deepening it to 20 ft. and greatly enlarging the locks is $25,000,000, which is a low estimate considering the previous cost of enlarging this work.

NIAGARA FALLS SHIP CANAL.

The United States Government has taken more or less interest in this project since 1867, Congress having at that time by joint resolution instructed the Secretary of War to have an examination made. This work was performed by Col. C. E. BLUNT, U. S. Engineer. His project was for a canal of 14 ft. depth with lock chambers of 275 × 46 ft. He examined six routes, some of which present great difficulty in the ascent of what is called the Niagara Terrace. In 1888 Congress appropriated funds for an examination for a water-way around Niagara Falls, its capacity to be sufficient to float ships drawing 20 ft. of water. The dimensions considered were: Width of canal at bottom, 100 ft.; depth, 20½ ft.; length of lock chamber, 400 ft., width, 80 ft.; depth over miter sill, 21 ft., and the lift in general to be 18 ft. The route is 25 miles long, number of locks, 18; estimated cost, $23,617,900. A revision of this estimate on the basis of larger locks and larger canal prism, and of an increase in price of rock excavation, which the author considers advisable, makes the total cost $35,000,000.

NIAGARA FALLS SHIP RAILWAY.

The estimate is made on the Twelve Mile Creek route of Col. BLUNT's surveys, beginning east of Cayuga Island, Niagara River, and ending at the mouth of Twelve Mile Creek. The length of the line is 18⅛ miles. The maximum grade surmounting the Niagara Terrace is 50 ft. per mile, a continuous grade of 4¾ miles. The total estimate on the same basis as the Hurontario Ship Railway, namely, for vessels of 5,000 tons displacement weight, 20 ft. draft, and an annual traffic of 8,000,000 tons, is $10,731,613, fully equipped.

MICHIGAN PENINSULA SHIP CANAL AND RAILWAY.

It is proposed to build a ship canal of the standard dimensions above given across the Michigan Peninsula from Benton Harbor on Lake Michigan to near Monroe on Lake Erie, a distance of about 160 miles. It would require 65 locks and the crossing of 19 railroads. The estimate is $138,405,432.

A ship railway across this peninsula fully equipped will cost not over $39,000,000, and the grades will not be heavy. The height to be surmounted at the summit is 475 ft.

LAKE CHAMPLAIN ROUTE BY WAY OF THE CAUGHNAWAGA RIVER.

The estimates made at various times for a 12-ft. canal with locks 270 × 45 ft., from the St. Lawrence River, about 8 miles above Montreal to Albany on the Hudson River, is about $20,000,000. To build this on the plan of the enlarged water-way now designed, and to deepen the Hudson from Albany to Hudson City, and to deepen Lake Champlain over long reaches, where there is now sufficient depth of water for a 12-ft. navigation, but not for 20 ft., would cost at least $50,000,000, and for the purposes of an unrestricted adequate waterway for deep draft vessels from the great lakes to the seaboard is apparently impracticable.

ERIE CANAL AND OSWEGO CANAL ENLARGEMENTS.

To build such a waterway as is now proposed between Buffalo and Albany would cost probably $250,000,000, and we would then have nothing but a continuous canal where the speed of vessels would be restricted. The Oswego canal enlargement can be dismissed also with the opinion that to enlarge it for deep draft vessels is impracticable. It has been suggested to build a ship railway instead on one or the other of these two routes. The author considers this impracticable, not only on account of its expense, but the natural and artificial obstacles that at points would prevent its construction. The Mohawk Valley is entirely occupied by two railways (six railway tracks), the Erie Canal, the Mohawk River, and an almost continuous line of cities and towns for long distances, these natural and artificial conditions being hemmed in on either side by steep and rugged bluffs of hard rock.

ST. LAWRENCE RIVER ENLARGEMENTS.

There remains the consideration, briefly, of the enlargement of the St. Lawrence River and its canals, to give an outlet to the seaboard for either the Hurontario Ship Ry. or the ship canals or ship railways at Niagara Falls and across the Michigan Peninsula. The very voluminous records of the Canadian Government have enabled the author to make an estimate for the enlargement of the canals and the deepening of the channels in the river itself between Montreal and Kingston. This estimate is based on the standard dimensions for an enlarged waterway used in making estimates of other routes. The total cost, assuming that the present canals have already been deepened to 14 ft. (this work is now being done by the Canadian Government), is $27,000,000.

TABLE OF SAILING DISTANCES, SPEED, TIME AND COST.

Table of Sailing Distances.	Statute miles.
New York to Liverpool	3,440
Boston to "	3,211
Philadelphia to "	3,625
Baltimore to "	3,891
Quebec to "	3,065
Quebec to Straits of Belle Isle	826
Straits of Belle Isle to Liverpool	2,239
Montreal to Quebec	160
Montreal to Liverpool	3,225

DISTANCE BY DIFFERENT ROUTES, CHICAGO TO MONTREAL.

1. Hurontario Ship Ry	1,001 miles.
2. Ottawa Navigation	979 "
3. Lakes, Welland Canal and St. Lawrence River	1,263 "
4. Michigan Peninsula Ship Ry. and Welland Canal	842 "
5. Michigan Peninsula Ship Ry., Niagara Falls Ship Ry., etc	841 "
6. Michigan Peninsula Ship Ry., Niagara Falls Ship Canal	841 "
7. All rail, Grand Trunk Ry	837 "

RATES OF SPEED (STEAMERS).

On the ocean and lakes, 15 miles per hour; ship railways and rivers, 10 miles per hour; on the canals, 7 miles per hour; on Welland and Niagara Falls canals, 4 miles per hour. Lockage and ship railway lifts and deflection tables, 30 minutes each. From this we obtain the following comparative sailing time from Chicago to Montreal:

SAILING TIME, CHICAGO TO MONTREAL.

	Hours.
1. Via lakes, Hurontario Ship Ry. and St. Lawrence River	93.14
2. Via Ottawa Navigation	100.17
3. Via Lakes, Welland Canal and St. Lawrence River	126.58
4. Michigan Peninsula Ship Ry. lakes, Welland and Niagara Falls canals, etc	107.04
5. Michigan Ship Ry. lakes and Niagara Falls Ship Ry	90.67
6. Michigan Ship Ry. lakes, Niagara Falls Ship Canal, etc	98.39

It is necessary to give the following notes for the purpose of ascertaining the correct basis of the cost per ton per mile. On this basis the tables which follow have been prepared:

ACTUAL RATES, SEASONS OF 1889 AND 1890.

The lowest summer rate from Chicago to New York was 20 cts. per 100 lbs. on grain, flour, etc., or $4 per ton, $4\frac{1}{10}$ mills per ton per mile via shortest line. About $\frac{7}{10}$ of the freight east and west comes under classes 4, 5 and 6.

At 25 cts. per 100 lbs. Chicago to New York (the regular schedule rate), or $5 per ton, the rate per ton per mile is $5\frac{17}{100}$ mills. The mean of these two rates is almost exactly one half cent per ton per mile.

The summer rate from Buffalo to New York is 11 cts. per 100 lbs., or $2.20 per ton = $5\frac{75}{100}$ mills per ton per mile. The regular rate on grain from Buffalo to New York is 13 cts. per 100 lbs., or $2.60 per ton = $6\frac{25}{100}$ mills per ton per mile.

The average rates from Chicago to Montreal are the same as from Chicago to New York, which would make a higher rate per ton per mile than is given above from Chicago to New York.

Taking same rates from Chicago to Montreal as rule to New York, we have:

Chicago to Montreal, summer rate, about 4¾ mills per ton per mile ($4\frac{75}{100}$ mills), and regular rate equals almost 6 mills per ton per mile.

It is safe to assume that the rates from Chicago to Montreal on export freight will never be much, if any, lower than those to New York.

Inasmuch as the ocean voyage from Montreal to Liverpool is only 190 miles shorter than from New York, the difference in rates could not be more than 10 cents per ton.

From the above it is safe to assume ½ cent per ton per mile for the railroad rate over all lines. Assuming this as the rail rate, and the following rates over different portions of the water route and over ship railways, we have the table given below. In order to fairly compare routes, the rate per ton per mile covers cost of operation of ship railways and canals and 6% interest on cost of construction.

TABLE.

	Mills per ton mile.
Rail rate	5
Rate over Hurontario Ship Ry	3.4
" " Niagara Falls Ship Ry	7
" on Lakes	1½
" " Ocean	½
" " Michigan Peninsula Ship Ry	3½
" " " " Canal	8
" " Ottawa Route	5
" " St. Lawrence Canals	7
" " Niagara Falls Ship Canal	12.5
" " Welland Canal	10

One of the conditions importantly affecting the various routes to the seaboard under consideration is the time lost during the year by the rigour of a northern climate. The effect which this suspension of navigation, of from 126 to 150 days out of the 365, will have upon the transportation question, it is difficult to estimate. A careful examination has been made of the length of time each year that different harbors will be closed by ice. The table prepared by Mr. L. E. COOLEY, late chief engineer of the Chicago drainage district, appears to be the most reliable, although authorities differ, and it is used to determine the length of time that each of the routes will probably be open for business:

Locality.	No. years observation.	No. days clos'd, ave.	Date closing.	Date opening.	Remarks.
Erie Canal	20	153	Dec. 3	May 5	Official clos.
Welland Canal	20	136	" 9	Apr. 24	Actual clos.
Buffalo, N. Y.	10	126		" 16	Say 126 days
Detroit River	7	121	" 2	" 2	
Straits of Mackinaw	20	140		" 20	Say 140 days
St. Mary's Canal	10	147	" 3	" 29	Actual clos.
Duluth	9	132	" 26	May 7	
Montreal	10	131	" 15	Apr. 24	
Hudson River	19	107	" 12	Mar. 29	Albany, N.Y.
Ill. & Mich. Canal	41	126	Nov. 26	Apr. 1	Official clos.
Illinois River 11 and 34		70	Dec. 25	Mar. 4	Morris, Ill.
Mississippi River	25	30½	" 23	Jan. 23	St. Louis Mo.

The following table gives the results of all of the preceding tables, relating to length of route, time of transit, cost per ton, and length of time that each route will be open.

CHICAGO TO LIVERPOOL.
Description of Route.

No. of Routes:	Length miles.	Time in hrs.	Cost per ton	No. days. route is open.
1. Hurontario Ship Ry. Lakes and St. Lawrence River	4,226	313.47	$3.48	225
2. Lakes and Ottawa Navigation	4,204	326.50	4.59	205
3. Lakes, Welland Canal and St. Lawrence Riv.	4,488	346.91	3.97	225
4. Mich. Pen. Ship Ry. Lakes, Welland Canal, etc	4,067. 25	327.37	3.66	229
5. Mich. Pen. Ship Ry. Lakes, Niag. Falls Ship and St. Lawrence	4,066	311.00	3.53	234
6. Mich. Pen. Ship Ry. Niag. Falls Ship Canal and St. Lawrence	4,066	318.72	3.70	229
7. All rail to Montreal	4,062	328.33	6.25	234
8. All rail to New York	4,333	337.33	6.74	365

Should the Canadian Government enlarge the St. Lawrence Canals at its own expense, and deepen the river where required, and remove the tolls to commerce from Lake Ontario to Montreal, as it has done seaward of Montreal, there can be deducted from total cost of transportation from the Great Lakes to Liverpool by this route 20 to 22 cts. per ton. The Hurontario route will then compare with the all-rail route to New York as $3.26 per ton is to $6.74, that is less than one half the cost by rail, or a saving to commerce in one year on 8,000,000 tons of traffic of more than the entire estimated cost of preparing the enlarged waterway from the foot of Lake Ontario to the sea.

The competition in English and other importing markets of Europe between the wheat of our Northwest, the Pacific Coast, India, Russia and the Argentine is so close that a substantial advantage in cost of transportation like the above to both Canadian and United States cereal producers will at once work a revolution in trade, and lead to an important development of agricultural products and to a material prosperity over the 450,000 square miles, compromising the basin of the Great Lakes, and extending to the lands outside and remote from it, but capable of reaching, by rail or water routes, its seaports, as the great cities of the lake will then be.

SHIP RAILWAY DISCUSSION.

The author has, without any hesitation, placed on an equality, as transportation methods, the ship railway and the ship canal. The former he considers superior in many respects.

1st. The cost of construction at each special location is more than 50% less than the cost of a ship canal to handle the same class of vessels and an equal amount of traffic.

2d. The cost of operation and maintenance will be less.

3d. The rate of speed will be greater, and there will be much less detention *en route*.

The New Gunboats.

The recent trials of the gunboat Bennington afford a means of ascertaining to some extent the progress made in naval architecture in this country. The Bennington is a sister ship to the Yorktown and the Concord. They are practically identical in dimensions, being 228 ft. long, 36 ft. beam, 18¾ ft. depth of hold from top of main deck beams to top of floors, and 14 ft. mean draft, although the Concord is rated at 14 ft. 4½ ins. Each has a maximum bunker capacity of 400 tons. The Yorktown was built by the Cramps, the others by the Quintard Iron Works.

The machinery is also of the same type. Each vessel has triple expansion engines with cylinders 22, 31 and 50 ins. in diameter, and 30 ins. stroke

Each has 4 steel boilers, 17¾ ft. long and 9¾ ft. in diameter, and in each boiler there are 3 corrugated furnaces with a maximum diameter of 41 ins. and a minimum of 37 ins.

The contract of the Yorktown called for the development of 3,000 HP., but she showed 3,392 HP. in her trials. This led the navy department to call for a minimum development of 3,400 HP. in the other vessels. The results of the trials are shown in the following table, taken from the New York *Sun*:

DATA OF TRIALS OF NEW GUNBOATS.

Name	Yorktown.	Concord.	Bennington.
Date of trial	Feb. 13, '90.	Jan. 13, '91.	Apr. 2, '91.
Total heating surface (one boiler), sq. ft.	2,022.97	2 052.42	2.052.42
Grate surface (one boiler)	55	55	55
Pitch of screw	12 ft. 6 in.	13 ft. 2.45 in.	13 ft. 8½ in.
Steam at boilers, lbs.	150.5	164.3	166.06
Steam at engines, lbs.	143.55	159 75	161 0o
Steam at first receiver, absolute	70.7	78.275	76.65
Steam at second receiver, absolute	20.15	28.77	33.17
Vacuum in condenser, ins	24.93	24.65	28.81
Revolutions of main engines	156.96	152.41	150.978
Temperature of injection, Fahr.	40.4	36	38.2
Temperature of discharge	92.6	105.5	92.8
Temperature of feed	96.8	139 9	125.8
Air pressure in ins. of water	1.25	2,292	2 45
Revolutions of blowers	757	497.5	511.82
Revolutions of air and circulating pumps	121.75	51.15	57.3
Mean effective pressure H. P. cylinders, lbs.	56.66	53.493	56.57
I. P. cylinders	34.19	29.566	27.50
L. P. cylinders	10.37	15.187	15.63
Indicated HP., H. P. cylinders	1,015.17	928.742	973 80
I. P. cylinders	1.220.67	1,026.759	945.61
L. P. cylinders	909.44	1,358.80?	1,403 39
Collective HP. of main engines	3,.05.28	3,314.303	3,322.80
Indicated HP. air and circulating pumps	118.79	27.328	36.62
Blower engines	52.03	34.774	45.92
Feed pumps	16.15	17.024	29.49
Dynamo engine	.....	8.00	7.76
Steering engine	.....	2.50	2.50
Aggregate HP. main engines and auxiliaries	3,302.25	3,404.529	3,436.09
Speed in knots, average 4 hours	16.14	16.8	17.5
Speed in knots, maximum	17.2	17.4	17.8
Contract price	$455.000	$490.000	$490.000
Premium	39,225	452.90	3,609
Total cost to U. S.	494,225	490.452.90	493.609

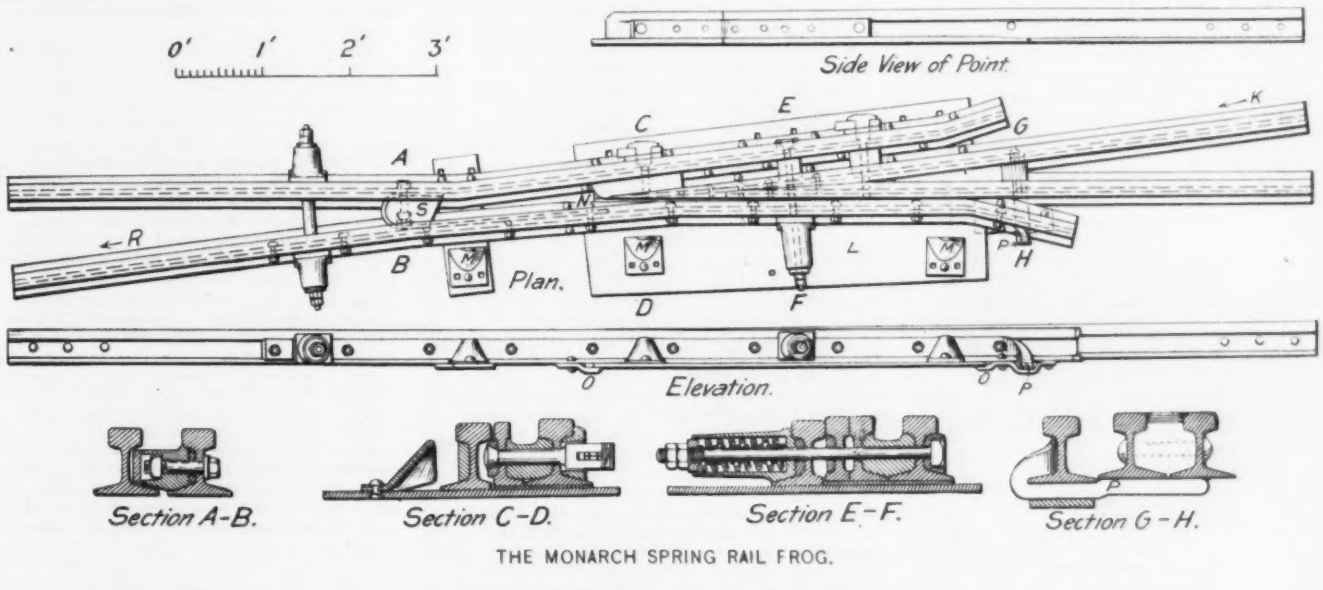
It will be seen from this table that the average speed under forced draft has risen from 17.2 knots to 17.5 knots, the collective horse power of the main engines from 3,205 to 3,223, and the horse power of all the engines from 3,302 to 3,436. While this progress is certainly gratifying, it is interesting to note that changes will be made in the Bennington that will, it is believed, make her still more serviceable.

The Monarch Spring Rail Frog.

We illustrate this week a new form of spring rail frog, which is claimed to be safer than the ordinary form, especially under fast and heavy traffic. It is claimed that an engine trailing a point switch may run with safety at any reasonable speed, but in trailing an ordinary frog, as at *K* in the accompanying cut, there is a well-known danger of derailment when the driving-wheels or frog are worn. In such case, the outer or false flange of the worn wheels is brought into contact with the spring rail near *L*, forcing it out and bending the stops *M*, so that the driving-wheels drop onto the ties at the throat of the frog *N*. The point of the frog naturally wears more than the spring rail, which tends to increase the liability to derailment by this action of the worn wheels.

In order to obviate this danger, the Monarch frog has the spring rail lowered any desired distance below the level of the top of the frog, preferably from ¼ to ⅝-in., as shown in the section *E F*, so that the outer or false flange of the wheel cannot strike the inner side of the spring rail and force the rail out, but passes over it and comes in contact with the outer side, thus hugging the spring rail tight to the frog. Other special features of this frog are the clips *O* and the monkey tail *P*, which prevent the rear end of the spring rail from rising when trucks are passing off the frog at *R*. An additional spring is used, as shown in the section *E F*. The spring rail bridle *S* prevents the creeping of the rail and the binding or getting out of line of the parts. The spring rail and frog point are strengthened by filling plates bolted on, as shown in the elevation and side view. Key bolts are used to tie the parts together. The plate under the frog may be solid, or in any number of sections as desired.

The Monarch frog was designed by Mr. N.W. BOYD, of Carlisle, Pa., and is manufactured by the Carlisle Mfg. Co., of that city.



THE MONARCH SPRING RAIL FROG.

Improvement and Traffic of the Harbor of Montreal, Canada.

The report of the Harbor Commissioners of Montreal for 1890, and that of Mr. JOHN KENNEDY, Chief Engineer, contain matter of general interest in connection with the cost of improvements and the growth of traffic. The harbor dredging plant consists of 2 boom spoon or dipper dredges, 1 crane spoon dredge, 3 clamshell derricks, 2 tugs, coal barge, floating shop and 14 scows. All of these have wooden hulls. For the work done during 1890 a stone lifter and 3 dump scows were borrowed from the Department of Public Works. The spoon dredges are about 77 ft. long, 27 ft. beam, and 6 ft. 6 ins. to 7 ft. 6 ins. depth of hold. The buckets have a capacity of 40 to 70 cu. ft., and the dredges will work to a depth of about 35 ft. The derricks are about 56 ft. to 61 ft. 9 ins. long, 24 ft. beam, and 5 ft. 9 ins. deep. The dredges and derricks are fitted with horizontal non-condensing engines; those of the former have 1 cylinder, 14 × 16 ins., and carry 60 to 90 lbs. pressure. Two of the derricks have 1 cylinder each, 8 × 12 and 10 × 12 ins., while the other has 2 cylinders, 7 × 12 ins.; they carry 75 lbs. of steam. The scows are 70 to 75 ft. long, 18 to 20 ft. beam, and 5 ft. to 6 ft. 5 ins. depth of hold. From tables and other matter in the report we have compiled Table No. 1, showing the amount and cost of work done during the year. Table No. 2, which is taken from the report, shows the quantities and cost of dredging since 1875.

TABLE NO. 1.—DREDGING AT MONTREAL 1890.

		Days.	Cu. yds. dredged.	Material	Ft. of water.	Av. cost per cu. yd.
Spoon dredge:	No. 6	4	720	Shale rock	25	$0.55
	No. 7	90	24,345	Sand and hard silt, with stones	30 to 31	.36½
	No. 4	157	63.067	162,213 cu. yds. of sand, tough silt and stones.	29 to 35	.25½
	No. 6	178	63,130			
	No. 7	86	31.035			
Stone lifter, No. 2		1	11			
"		80‡	392	Boulders.	.....	6.98
Total		506	187,670	.....	.....	.....

TABLE NO. 2.—COST OF DREDGING AT MONTREAL, 1875 TO 1890.

YEARS.	Cu. yds. dredged.	Total cost.	Cost per cu. yd. Cts.
1875	151,719	$68,979	45
1876	156,082	55,462	35.5
1877	173,499	45,103	26
1878	211,731	48,748	23
1879	189,009	41,006	21.63
1880	186,430	43,914	25.16
1881	170,764	54,128	31.69
1882 †	187,339	53,598	28.60*
	9,429	13,254	140.60†
Total	196,768	66,852	33.96
1883 †	36,358	17,956	49.38*
	6,990	19 385	277.30‡
Total	43,348	37,341	86.14
1884	125,648	49,468	39.37*
1885	69,494	28,563	41.10*
1886	57,728	25,772	44*
1887	36,903	23,259	62*
1888 †	73,150	36,600	50.16*
	2,077	1,333	64.18†
Total	75,227	38,023	50.54
1889 †	205,283	54,574	26.58*
	9,420	2,996	31.80†
Total	214,703	57,570	26.81
1890	187,670	$53,674	28.60*

* Spoon dredges and stone lifters.
† Elevator dredges.
‡ Elevator dredges lifting rock and boulders, and clearing up.

The opening and closing of navigation average about April 22 and Dec. 16 respectively, giving about 8 months (all but 6 days) for navigation. The tonnage of the traffic of the port during each fifth year since 1850 is shown in Table No. 3. The ocean steamship traffic began in 1853 and 1854, but there was no such traffic in the year 1855. The records of inland vessels up to 1853 have been destroyed. The table shows a steady growth in ocean steamship tonnage

since its commencement and a sharp decline in ocean sailing ship tonnage since 1880.

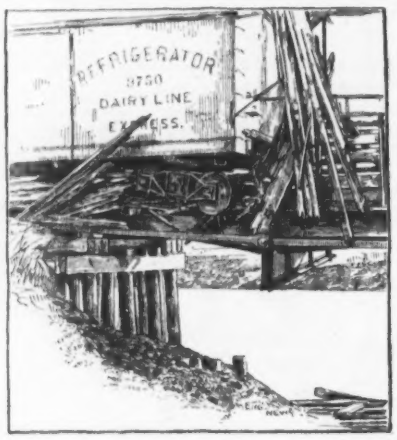
Table No. 3.—Total Tonnage of Vessels Arriving at the Port of Montreal, 1850 to 1890.

YEARS.	Ocean steamships.	Ocean sailing ships.	Total ocean vessels.	Inland vessels.	Grand total.
1850.....	.....	46,867	46,867	.....	46,867
1855.....	.....	48,154	48,154	312,001	360,155
1860.....	47,385	74,174	121,559	346,652	470,211
1865.....	78,015	74,928	152,943	626,550	779,493
1870.....	133,912	182,934	316,846	819,476	1,136,322
1875.....	255,435	130,677	386,112	811,410	1,197,525
1880.....	475,741	152,530	628,271	1,044,380	1,672,651
1885.....	619,647	64,207	683,854	724 975	1,408,829
1890.....	889,189	41,143	930,332	966,959	1,897,291

We shall publish shortly some particulars of the new work for the improvement of the harbor, plans for which have been adopted.

An Interesting Bridge Accident.

We are indebted to Mr. WM. GRAHAM for a photograph of the interesting bridge accident illustrated in the accompanying cut. The bridge in question crosses the Floyd River at Sioux City, Ia., and belongs to the Union Stock Yards Co. It is a 180-ft. span, combination structure, having 11 panels.



Accident to Floyd River Bridge, Sioux City, Ia.

The floor beams are iron and the stringers timber. The bridge is floored and fenced for driving stock. The approaches are on 12° curves and have outside wooden guard rails only, projecting 4 ins. above the floor planks, low enough for the car to pass over easily in the accident. The train consisted of an empty car and pusher engine. The car truck jumped the track on the curve about 40 ft. from the end of the bridge, and knocked out the end post as shown. This post was of three pieces, 11 × 16 ins., white pine, and in sound condition.

The structure was apparently held up by the secure anchorage of bolsters at both ends, the bottom chord acting like the cable of a suspension bridge. The rollers and roller shoe were rusted fast and apparently had not moved for years.

Block Signaling.

At the meeting of the New York Railroad Club on April 16 a paper with the above title was read by Mr. GEO. H. PAINE. Comparing the absolute, space-blocking system with the "time limit" system, he said that a great many disembodied human souls would doubtless be willing to testify, if they could, to the inherent dangers of the latter. "Permissive blocking" he condemned in the strongest terms, and suggested that its name should be changed to the more appropriate one of "pernicious blocking."

The best form of signal is the semaphore, and it will probably come in time to be the standard. Some types of automatic electric signal systems, however, have thus far not been able to use the semaphore form on account of the weakness of the battery current by which the signal is operated. The best form of night signal is a much-disputed question, but the author favored the illuminated semaphore (described and illustrated in ENGINEERING NEWS of Sept. 22, 1889, provided the intensity of the beam of light could be increased and the cost could be reduced.

For single-track roads doing an average business the author recommended the simplest form of block system, operated, so far as possible, by the regular employees at the stations. The shorter the blocks, the heavier the traffic which can be accommodated. With stations five miles apart, the author estimated the practicable traffic as at least 24 trains each way daily. With 4-mile blocks, at least 30 trains each way daily could be run. Of course the extreme limit of train movement under the block system depends on so many different conditions that no general rule for determining it can be given.

We quote from the paper as follows:

The method is of the most elementary character. It requires nothing but the telegraph operator, who would be needed at almost every station even if there were no block system, and a two-arm semaphore post connected with the telegraph office by a piece of wire or chain.

With blocks averaging 5 miles in length, the first cost of materials necessary would not, I believe, much exceed $15 per mile. The increased cost of operation would vary greatly over and above certain fixed charges, such as oil and waste for the signal lamps; it might easily be very little, and could not be very much. The most important item would be the additional operators required over and above those necessary for the ordinary work of the road. This would depend greatly on the ingenuity and care used in the locating of the block stations.

There are many ways of operating a block system of this kind, each one of which has its advantages and disadvantages. It would be impossible to describe each of them, for their name is legion, and I do not know of any two which are exactly alike. The one feature common to all is the electrical communication existing between each signal station and the stations immediately on each side of it. Sometimes the signalmen communicate with each other by bell taps, and sometimes by the regular Morse instrument. One code of bell taps which I have seen covers 18 different meanings (an English one, by the way, and for absolute blocking only), and an operator is required to ask and receive permission of the man in advance of him in three different ways before clearing a signal. There is a certain effort of memory imposed by this method which is objectionable from the fact that forgetfulness is one of the most fruitful causes of disaster on railroads. There is also an opportunity offered to those lazy or over-confident operators who imagine that they do not need the protection thrown around them by so many repetitions of the same question.

The Sykes system aims to eliminate this danger, and *does* it when used exactly in the way which it was designed for. I will not go into the minutes of the Sykes instruments, but shall content myself with saying that an operator desiring to give a signal must ask the man in advance to "unlock" him. This the advance man does by what is called "plunging." In plunging he releases the lever of the man in the rear, and locks his own lever. A mechanical arrangement also exists in all Sykes machines which prevents a man from plunging more than once between the passage of each two trains moving in the same direction.

The Sykes system is of very great advantage, and is to be recommended on railways where the block signals are not so close together as to make the cost of operation excessive.

AUTOMATIC BLOCK SYSTEMS.

There is a point where the cost of the maintenance of a system whose first cost is small makes it more expensive than a system whose first cost is large; and block stations should be, if possible, so located as to permit of a convenient and inexpensive extension of the system as the increase of traffic demands it. This brings us to the question of automatic signals.

Automatic block signals were designed to do two things: First and foremost, they are intended to eliminate as far as possible the element of human interference in their workings; and, next, to avoid the excessive cost of operating where signalmen are required.

The author then described the Hall system, the Union electric system, used extensively in New England, and the electro-pneumatic system of Mr. GEO. WESTINGHOUSE. The Hall system was fully described in ENGINEERING NEWS of Sept. 13 and Sept. 20, 1890, and Jan. 24, 1891. The Westinghouse pneumatic system was described by Mr. R. H. SOULE in our issue of Dec. 28, 1889.

A distinctive feature of the system is that the electric circuit is carried along the track rails in the Union and the Westinghouse systems and on a wire mounted on the telegraph poles in the Hall system.

Concerning the relative cost of the automatic and non-automatic systems, the author emphasized the fact that the chief expense of the automatic system was in first cost. The system with blocks controlled by signalmen costs little to install, but its operating expenses are heavy.

The point at which it is an economy to abandon the use of operators and to adopt an automatic system probably lies somewhere between three-mile blocks and one-mile blocks. I think there would be an economy in abandoning the use of operators when the traffic of the road had increased so much as to require the signals to be less than three miles apart. Circumstances, of course, might exist where this estimate would be wholly wrong, as, for instance, in a very thickly populated country where all-night stations would have to be maintained very close together, it might be an economy to still continue the use of operators, but my belief is that the greater efficiency of automatic signals would enforce their use long before the limit mentioned had been reached.

Comparing the cost of operating the Westinghouse pneumatic system, and the system using signalmen, the author said:

I have been told by persons using the pneumatic system that the signals should be properly maintained at an expense of about $90 per block per year. This would include the fuel, oil and waste necessary for operating the compressors and filling and cleaning the lamps, as well as the pay of all men employed in inspecting, operating and maintaining the system. Although the cost of a plant of this character is large at the start, the cost of maintenance is so slight in comparison with the cost of maintenance of a mechanical system that its advantage will be seen at once.

On a certain railroad the system of pneumatic-automatic signals has been put in, embracing a section of road seven miles long, four main tracks, with the block signals about half a mile apart. A mechanical system of the same length, with the block stations the same distance apart, would have cost to erect less than half as much as did the automatic-pneumatic. The cost of operating the mechanical system for one year, however, including the pay of operators, 22 of whom would have been required, would have been equal to about three times the sum which it has cost to maintain and operate the automatic, and in four years from the date that the automatic system was put in service this saving will have much more than paid for it, without at all taking into consideration the entire immunity from collisions which has been procured. This proportionate gain increases rapidly as the length of road protected is increased.

To give another illustration; all the elements of cost of a 14-mile section of double track road, with the blocks varying from 1,500 ft. to 2,650 ft. in length, have been estimated. To erect a mechanical system of the same size would have cost somewhat less than one-third as much. To maintain and operate the mechanical, would have cost four times as much as the pneumatic, and the net yearly gain in favor of the pneumatic would have paid its original cost in the amazingly short time of two years.

THE LOUISVILLE & JEFFERSONVILLE BRIDGE CO. is preparing to resume work on its new bridge across the Ohio River at Louisville, Ky. Nearly all of the ironwork has been completed ready for shipment at the shops of the Phœnix Bridge Works, and work on the masonry is well advanced toward completion. Resident Engineer ENGLE states that work will be resumed within a month, and the structure completed this season.

THE RELATIVE COST OF COAL AND WOOD AS FUEL FOR LOCOMOTIVES was the subject of a series of tests on the Southern Pacific Ry. during the past winter. These tests, as reported by the *Railway Review*, were made on the Sacramento Division, which is 1,195 miles long and contains some of the heaviest grades on the lines. The locomotive making the tests ran three round trips, each with wood and coal as fuel, between Dec. 19, 1890, and Jan. 2, 1891. The following table gives the results of the tests:

	Wood.	Coal.
Locomotive miles.....	717	717
Car miles.....	6,813	5,228
Coal used, tons.....	.....	36.35
Wood used, cords.....	42.05	
Av. weight train, exclusive of engine and tender, tons.....	170.81	183.65
Weight train hauled 1 mile, exclusive engine and tender, tons.....	122,494	131,700
Fuel used per locomotive mile, cords	.0587	
" " " " " tons.		.0507
Fuel used per car mile, cords.....	.00617	
" " " " " tons.....		.0069
Fuel used per 1,000 tons weight of train hauled 1 mile, cords.....	.343	
Fuel used per 1,000 tons weight of train hauled 1 mile, tons.....		.276
Cost of fuel per cord.....	$4.35	
" " " per ton.....		$5.00
Cost of fuel per 1,000 tons weight of train hauled 1 mile.....	$1.49	$1.38

The coal used was from mines near Evanston, Wyo., and analyzed: moisture, 7.55%; volatile matter, 34.65%; fixed carbon, 42.85%, and ash 14.95%. The wood was cut from soft timbers, mostly fir, spruce and white and yellow pine, and was thoroughly seasoned. The figures show very little difference in the cost of the two fuels, coal being about 7% cheaper.

PERSONALS.

Gen. JOHN NEWTON has resigned his position as Consulting Engineer of the Chicago Drainage Canal.

Mr. J. B. GASS has been re-elected City Engineer and Inspector of Plumbing and Sewers at Fort Smith, Ark.

Mr. H. C. POTTER, Vice-President and General Manager of the Flint & Pere Marquette R. R., has resigned.

Mr. G. R. CAMPBELL, President and General Manager of the Campbell Frog & Crossing Works, Bucyrus, O., died April 15.

Mr. W. H. MCDOEL has been appointed General Manager of the Louisville, New Albany & Chicago R. R., vice Mr. W. F. BLACK, resigned.

Mr. E. DICKINSON, Superintendent of the Baltimore & Ohio lines west of the Ohio River, has returned to the Union Pacific as Assistant General Manager, vice Mr. W. H. HOLCOMB, resigned.

Mr. B. CUTTEN has been appointed General Superintendent of the Chesapeake & Ohio Southwestern Ry., vice Mr. J. L. FRAZER, resigned. He was formerly Division Superintendent of the Northern Pacific.

Capt. GEO. C. DICKINSON, M. Am. Soc. C. E., late Division Engineer of the Hudson Suspension Bridge & New England Ry. Co., has been appointed Chief Engineer of the Broadway & West Virginia Ry., with office at Broadway, Va.

Mr. W. G. OAKMAN, First Vice-President of the Richmond & Danville R. R. Co., has resigned and accepted the office of First Vice-President of the Central Railroad of New Jersey, vice Mr. JOSEPH S. HARRIS, of Philadelphia, resigned.

Mr. DANIEL MCCAIN, Sr., died this week at Rankin, Pa. He was largely engaged in bridge building, and with his sons, F. J. and D. MCCAIN, carried out the ironwork of the Chicago Auditorium. His sons form the firm of F. J. McCain & Bro., of Chicago, Ill., contractors for ironwork.

The ADAMS ENGINEERING CO., consisting of F. K. ADAMS, C. E.; W. W. HABERSHAM, E. M.; C. H. ADAMS, M. E., and JULIUS L. ADAMS, C. E., has been organized in Atlanta, Ga., for general engineering practice. Its specialties will be mill construction, mining reports, municipal works, etc. The last named member of the firm is a nephew of Col. J. W. ADAMS, M. Am. Soc. C. E.

Mr. CHARLES A. LAMOREUX has been appointed Superintendent of the St. Paul Division of the Wisconsin Central R. R., with headquarters at St. Paul, vice Mr. A. R. HORN, who will go to Stevens Point to take the superintendency of the Portage, Chippewa, Ashland and Penokee divisions, made vacant by the resignation of Mr. CHARLES CUTTER, who goes to the Chesapeake & Ohio Ry. as Superintendent of Transportation.

SOCIETY PROCEEDINGS.

Eleventh Annual Convention of the American Water-Works Association.

(*Concluded from page 373.*)

The first two days' proceedings of the eleventh annual meeting of the Association, held last week at Philadelphia, were given in full in our last issue. The business of the session practically closed Thursday morning, and the remainder of the time was spent in excursions.

THURSDAY MORNING.

The session opened with the election of Mr. G. W. Henshaw, of Winston, N. C., as an active member of the Association. Then followed a paper on "Water Motors," by Mr. Stephen E. Babcock, of Little Falls, N. Y., which we reprint, slightly abbreviated, elsewhere in this issue.

The above paper was followed by an interesting discussion. Mr. Chase, of Wilmington, N. C., wished to know how the horse-power developed compared with the nominal power of the motors. Mr. Babcock replied that some of the motors had been tested to 67½% of the theoretical power of the water used, but could not answer Mr. Chase's question. Mr. Steben, of Brockville, Ont., was of the opinion that motors use more water than they are rated to do. Mr. Milne, of New York, thought that the efficiency of the motor differed with the modes of using, rather than with the make.

The "Purification of Water by Metallic Iron" was next presented by Dr. Henry Leffman, of Philadelphia. Dr. Leffman gave an explanation of the Anderson process of purifying water, which was largely verbal and was illustrated by samples of water which had or had not been treated. Readers of ENGINEERING NEWS are already familar with the process, or can become so by referring to the issue of that journal for Sept. 5, 1885, pp. 147-9, where will be found an illustrated paper by the inventor of the process, Mr. William Anderson, M. Inst. C. E., and another by Mr. G. H. Ogston, Assoc. M. Inst. C. E.

For convenience the following brief extracts, descriptive of the proce s, are reprinted from Dr. Leffman's remarks:

The method is very simple. Metallic iron in the form of either cast-iron borings or steel punchings is placed in a cylinder so arranged that, by a slow rotation, the iron may be continuously showered through the water, which is being passed at moderate speed through the same cylinder. The cylinder is provided with pipes, by which air may be introduced in direct contact with the iron, if necessary. The chemical action consists in great part in the conversion of the iron into ferrous carbonate (proto carbonate of iron) through the agency of the carbonic acid, which partly dissolves in the water and partly remains suspended in the form of dark green turbidity. On exposure to the air, the iron is converted into ferric hydroxide (hydrated sesquioxide of iron) which, settling rapidly, carries down with it, and oxidizes the organic matter. The flocculent sediment permits of rapid and perfect filtration through a simple sand filter. In addition to the above chemical effect, it is probable that in some waters, *e. g.*, those containing much dissolved organic matter, a direct oxidation of this occurs at the same time that the iron is acted on, with the result that the iron salts of organic acids are developed, and these are subsequently thoroughly oxidized when exposed to the air.

Other points brought out by Dr. Leffman were as follows: The use of chemicals is avoided by this process and the purification is effected in 3½ to 5 minutes, for moderately bad water, and in 5 to 15 minutes for sewage effluents. Both chemical and bacteriological examinations show that the process is very effective.

In the discussion which followed, Mr. E. Devonshire, who, it is but fair to state, represents the Revolving Purifier Co., which is introducing the process in this country, added some information, as follows: In case the water to be purified contains clay, the precipitant is in such large flakes that it will settle by its own weight. Mississippi River water might be purified without passing it through a filter bed after it had been put through the purifier. On the other hand, Delaware River water contains such fine sediment as to make filtration a necessary accompaniment to the process. The aim of the process is to get the coarsest possible precipitant, and to filter as little as may be. In filtering great care should be taken not to draw the precipitant into the filtering material, as this lessens the efficiency of the bed. To avoid this, a slow rate of filtration should be used. Cast-iron borings are more active as a purifier than steel plate punchings. The best size for the latter is from ⅜ to ⅝ ins., although as large a size as ⅞ ins. have been used.

In the course of the discussion the fact was brought out that the process is now in use at Antwerp, Dordrecht and Gouda, Holland; Paris, Nancy and Libourne, France; Baroda and Agra, India; and Monte Video, Uruguay. Also that a 100,000-gall. experimental plant is in use at Lardner's Point, on the Delaware River, in connection with the Philadelphia water-works, and that the cost of purification at Dordrecht, Holland, is $1.10 per million gallons.

The two last papers on the programme were not read. Mr. Morse, who was to have read a paper on "Private *vs.* Public Water-Works," not being present, and Secretary Diven having been excused from reading his paper on the "Best Form of Contract Between Water Companies and Municipalities for Public Water Supply."

The report of the Committee on Nominations was next read and the officers nominated elected, as follows: President, J. M. Diven, Elmira, N. Y.; Vice-Presidents, G. H. Benzenberg, Milwaukee; J. L. Ogden, Philadelphia; J. A. Bond, Wilmington, Del.; H. G. Holden, Nashua, N. H.; W. G. Richards, Atlanta. Acting Past-President, W. B. Bull, Quincy, Ill. Finance Committee, P. J. Donahue, Davenport, Ia.; William Molis, Muscatine, Ia.; William Ryle, Paterson, N. J. Secretary and Treasurer, J. H. Decker, Salina, Kan.

The next business was the choosing of a place for the next meeting. The Secretary read communications from the Commercial Club, Board of Trade and Mr. F. A. W. Davis, Vice-President of the water company, inviting the Association to hold its next meeting at Indianapolis. Mr. J. B. Fish invited the Association to meet next year at Scranton, and Mr. Lewellyn, of Chattanooga, invited it to meet in that city. Mr. J. C. Kelley, of New York, suggested that city. On an informal ballot the vote was as follows: New York, 33; Indianapolis, 13; Chattanooga, 8; Davenport, Ia., 4; Scranton, 2; Minneapolis, Atlanta and "Kelley's Island," one each. On motion, it was decided by acclamation to hold the next meeting at New York.

THE DRIVE AND THE EXCURSION.

Thursday afternoon, through the courtesy of the local committee, the Association were treated to a drive through Fairmount Park, with stops at the Spring Garden, Fairmount and Belmont pumping stations of the Philadelphia water-works, and finally at the Belmont Mansion, where an elaborate luncheon was served. At this point a photograph of the party was taken. Those wishing to secure a photograph may do so by addressing Herbert Hoffman, 914 Arch St., Philadelphia. The price is one dollar each.

At 9 A. M. Friday, the local committee had ready a special train on the Pennsylvania Railway, to take the party to Atlantic City. On the way a stop was made at the Camden Iron Works, one of three large founderies and shops of R. D. Wood & Co. Here a practical, though unintentional, illustration of the value of pressure and hammer tests of cast-iron pipe was given, a length of pipe bursting while being tested and sprinkling a number of visitors.

At Atlantic City dinner was served at the United States Hotel, and a pleasant hour was spent upon the beach before returning to Philadelphia. The weather on Friday, and throughout the week, was very pleasant.

FRIDAY EVENING.

A rather informal meeting was held Friday evening, at which resolutions offered by Mr. L. H. Gardner, of New Orleans, were passed. These included votes of thanks to the local committee and local press, and to President Bull.

THE EXHIBITORS.

As usual, at these conventions, several of the associate members exhibited some of the specialties which they manufacture. The exhibitors this year were as follows, the character of their exhibit being stated when not indicated by the name: Standard Thermometer Co., Peabody Mass., thermometers and pressure recording instruments; Thompson Meter Co., New York; Union Meter Co., Worcester, Mass.; National Meter Co., New York; Hersey Manufacturing Co., South Boston, Mass., meters; Illinois Malleable Iron Co., Chicago, Ill.; A. P. Smith, Newark, N. J.. Smith tapping machine; W. M. Clarke, Newark, N. J., Newark tapping machine and corporation cocks; Walworth Manufacturing Co., Boston Mass., Hall tapping machine; Brass and Iron Works Co., Fostoria, O., Payne's tapping machine; Mellert Foundry & Machine Co., Reading, Pa., hydrants; Galvin Brass & Iron Works, Detroit, Mich., hydrants; R. D. Wood & Co., Philadelphia, valves and hydrants; I. S. Cassin & Co., Philadelphia, hydrants; Holyoke Hydrant Co., Holyoke, Mass., Fisher Governor Co., Marshalltown, Ia., gravity; and steam pump governor and boiler pressure-reducing valves; Philadelphia Scale & Testing Machine Works, Riehlé Bros., Proprietors, Philadelphia.

Engineering Association of the South.—The regular monthly meeting was held at Nashville, Tenn., April 9; First Vice-President W. L. Dudley presiding.

A resolution was adopted, relative to the convention of the American Society of Civil Engineers which is to be held at Lookout Mountain, Tenn., in May, inviting the Society to include Nashville in its route and to hold one of its sessions at that place.

The paper of the evening on "The Engineering Profession," was presented by Maj. W. F. Foster, of Nashville. He treated the subject under three heads. First, the relation of the members of the engineering profession to one another; second, the relations of engineers to their clients; third, the relation of engineers to the general public. The writer held that engineers in charge of work should take a greater interest in the welfare and professional advancement of their subordinates, and that a spirit of mutual aid and good faith should be characteristic of the intercourse between engineers rather than one of professional reserve and criticism. No tolerance should be shown to pretenders, for whose exclusion it was suggested that it might become desirable to inaugurate a system of state examinations and licenses. Maj. Foster dealt strongly on the importance of engineers maintaining their true status as arbitrators between their clients and their contractors, and not simply act as the agents of their clients; and was of the opinion, that while not generally proper, still in certain cases under certain conditions and clearly defined stipulations, professional work might be undertaken for a fixed compensation, regardless of the time or the difficulties to be encountered. The practice, however, of bidding for engineering work was held to be all wrong in theory and bad in effects, undignified and unprofessional.

Civil Engineers' Club of Cleveland.—A regular meeting was held April 14, President Gobelle in the chair.

The paper of the evening was by Prof. Charles H. Benjamin on "The Education of the Mechanical Engineer." He stated that to obtain the best results the hand and eye must be educated at the same time as the mind, that the engineer must be taught to think for himself, that the solution of original problems is one of the very best means of education, producing lasting impressions and making the student independent and self-reliant; that the brain is not a storehouse but a workshop, and it is this that has raised mechanical engineering from a trade to a profession; that one who has a vast amount of information is learned but not necessarily educated, and, last, that to become a successful mechanical engineer there should be a natural aptness for this profession.

New York Railroad Club.—At the meeting on April 16 a paper was read by Mr. Geo. H. Paine on "Block Signaling." An abstract is reprinted elsewhere. The discussion of amendments to the Rules of Interchange then began, and was made more amusing, if not more valuable by the prominent part taken by one or two members of the New England Railroad Club who were present. Their ideas concerning the amendment of the rules did not generally correspond with those of the members of the club, and were promptly and unanimously defeated when put to vote. In general the amendments recommended were nearly the same as those recommended at the recent meeting of the Central Railway Club of Buffalo. As the members who took part in the discussion and carried the amendments were nearly all members of the Central Railway Club, not much importance is to be attached to the New York Club's action.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

Vol. XXV. Saturday, April 25, 1891.

D. McN. Stauffer, A. M. Wellington.....Editors
Chas. W. Baker, E. E. R. Tratman, M. N. Baker, F. P. Burt, } Associate Editors
Geo. H. Frost.....Business Manager

Subscription Rates: *One Year,* **$5.00;** *6 months,* **$2.50;** *4 months,* **$2.00;** *Single Copies, 12 cents. To all* **Foreign Countries** *in the Postal Union, add $2.08 to above prices for postage. Subscribers can have the mailing address of their paper changed as often as they desire. Send both the old and the new addresses.*

The date *when the subscription expires is on the address label on each paper, the change of which to a subsequent date becomes a receipt for remittance* **No other receipt** *is sent unless requested.*

Advertising rates, 20 cents per line *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon:* **New** *advertisements Wednesday afternoon:* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

Denver Society of Civil Engineers.—April 28, "Colorado Irrigation Laws." Secy., Geo. H. Angell.

Association of Civil Engineers of Dallas.—May 1. Secy., E. K. Smoot, 803 Commerce St.

Engineers' Club of Philadelphia.—May 2. Secy., Howard Murphy, 1122 Girard St.

Northwest Railroad Club.—May 2. Secy., H. P. Robinson, St. Paul, Minn.

Civil Engineers' Society of St. Paul.—May 4. Secy., C. L. Annan.

Engineers' Club of St. Louis.—May 6. Secy., Arthur Thatcher, Room 801, Odd Fellows' Building.

American Society of Civil Engineers.—May 6. Annual meeting, May 20, at Lookout Mt., Tenn. Secy., Francis Collingwood, 127 E. 23d St., New York.

Western Society of Engineers.—May 6. Secy., J. W. Weston, 280 La Salle St., Chicago.

Engineers' Club of Minneapolis.—May 7. Rooms, Public Library Bldg. Secy., F. W. Cappelen.

Technical Society of the Pacific Coast.—May 8. Secy., O. von Geldern, 819 Market St., San Francisco.

Engineers' Club of Kansas City.—May 11. Rooms, Baird Building. Secy., H. Goldmark.

Civil Engineers' Club of Cleveland.—May 12. Secy., A. H. Porter, 50 Euclid Ave.

Civil Engineers' Association of Kansas.—May 13. Secy., J. C. Herring, Wichita, Kan.

New England Railroad Club.—May 13. Secy., F. M. Curtis.

Engineering Association of the South.—May 14. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

Northwestern Track and Bridge Association.—May 15. Secy., D. W. Meeker, St. Paul, Minn.

Engineers' Society of Western Pennsylvania.—May 19. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—May 20. Secy., S. E. Tinkham.

Western Railway Club.—May 21. Rooms, Phenix Building, Chicago. Secy., W. D. Crosman, 816 Rookery Bldg.

Engineers' Club of Cincinnati.—May 21. Secy., J. F. Wilson.

New York Railroad Club.—May 21. Rooms, Gilsey House. Secy., H. G. Prout.

A GENERAL INDEX TO ENGINEERING NEWS, extending from the first issue of Volume I., in 1874, to the end of Volume XXIV. (July–December, 1890), is now in press, and will be issued about May 1 in a separate small volume handsomely bound in cloth, which will be sold at $1. It will prove a valuable work of reference even for those whose files are not complete.

WE fear there is imminent danger that in the otherwise excellent revision of the building laws of the city of New York, which is now pending before the legislature, certain very absurd and injurious new provisions as to columns and factors of safety will become law unless some one takes the trouble to give the legislature timely warning and is listened to. The effect of these provisions is not merely to discourage the use of wrought iron and steel in buildings in place of cast iron, but to practically prohibit their use, and so confine New York architects to the use of cast iron only, which the law should energetically discourage rather than encourage. The provisions thus objected to will be readily detected by engineers in the following literal extracts from Assembly Bill No. 1,481, third reading. They may have been inserted either from ignorance or design, but it is hard to imagine that any one who would venture to advise at all as to the drawing of such a bill could insert such absurd provisions from ignorance; while they are so plainly in the interest of the New York City foundries that they may reasonably be suspected of having surreptitiously procured the insertion of these provisions. If they become law, they will surely put a rude check upon the present rapid progress in the use of a reliable building material instead of a treacherous one, which it would be much more reasonable to wholly exclude from use in buildings as it is from use in bridges in modern practice. The provisions referred to are as follows:

Every column, post or other vertical support shall be of sufficient strength to bear safely the weight of the portion of each and every floor depending on it for support. In addition to the weight, as before stated, to be supported safely upon special portions of said floors, the dimension of each piece or combination of materials required *shall be* ascertained by computations according to the rules given in Trautwine's "Civil Engineers' Pocketbook," except as may be otherwise provided for in this title.

The strength of all columns and posts *shall be* computed according to Gordon's formulæ, and the *crushing* weight in pounds to the square inch of section for the following named materials shall be taken as coefficients in said formulæ, viz.:

Cast iron	80,000 lbs.
Wrought or rolled iron	40,000 lbs.
Rolled steel	48,000 lbs.
etc., etc.	

The factor of safety shall be as 1 to 4 for all beams, girders or other pieces subject to a transverse strain, and as 1 to 5 for all posts and vertical supports to a compressive strain, and as 1 to 6 for all tie-rods, tie-beams and other pieces subject to a tensile strain.

THE crushing strengths given under these provisions will be about right for very short columns, albeit it gives to a given cast-iron column about twice the crushing strength of either wrought-iron or steel columns of the same section. But the provisions as to factors of safety are so absurd as to be laughable. In the first place, while stipulating coefficients for the numerator (f) of Gordon's formula, they make no stipulations for the even more important coefficient (a) in the denominator, which leaves room for considerable jockeying. Secondly and chiefly, inasmuch as rolled iron and steel are the most reliable of all building materials and cast iron the most unreliable, to stipulate for the same "factors of safety" for them is contrary to all reason and good practice; not more than $\frac{1}{12}$ to $\frac{1}{8}$ of the breaking load can safely be placed on cast columns. The present rules permit a factor of 5, but it had much better be 10, especially for such columns as are largely used in New York buildings, cast directly from the blast furnace, and wholly undressed at base and top, so that there is no assurance of uniformity of load. On the other hand, a safety factor of 3 or 4 is recognized good practice for either beams or columns of wrought iron or steel in buildings, and a factor of 2 would be safer for wrought iron or steel than 5 is for cast iron. We do not now undertake, of course, to specify just how these provisions should be worded in the law. "Factor of safety" provisions in any form are a crude way of expressing such requirements, and it is a matter demanding much more consideration than we care to give to the subject at this time to advise a specific wording which may not be listened to. We now confine ourselves to pointing out that the provisions of the pending bill on this subject are utterly improper and inadequate as they now stand. Bearing in mind that cast iron and wrought iron or steel stand to each other in price about as 2 cts. to 3 cts., it will be seen at once that a surer way to compel the universal use of a bad material with dangerously narrow limits of safety, and to discourage and prohibit the use of good material by unreasonable exactions, could hardly be desired than those quoted above.

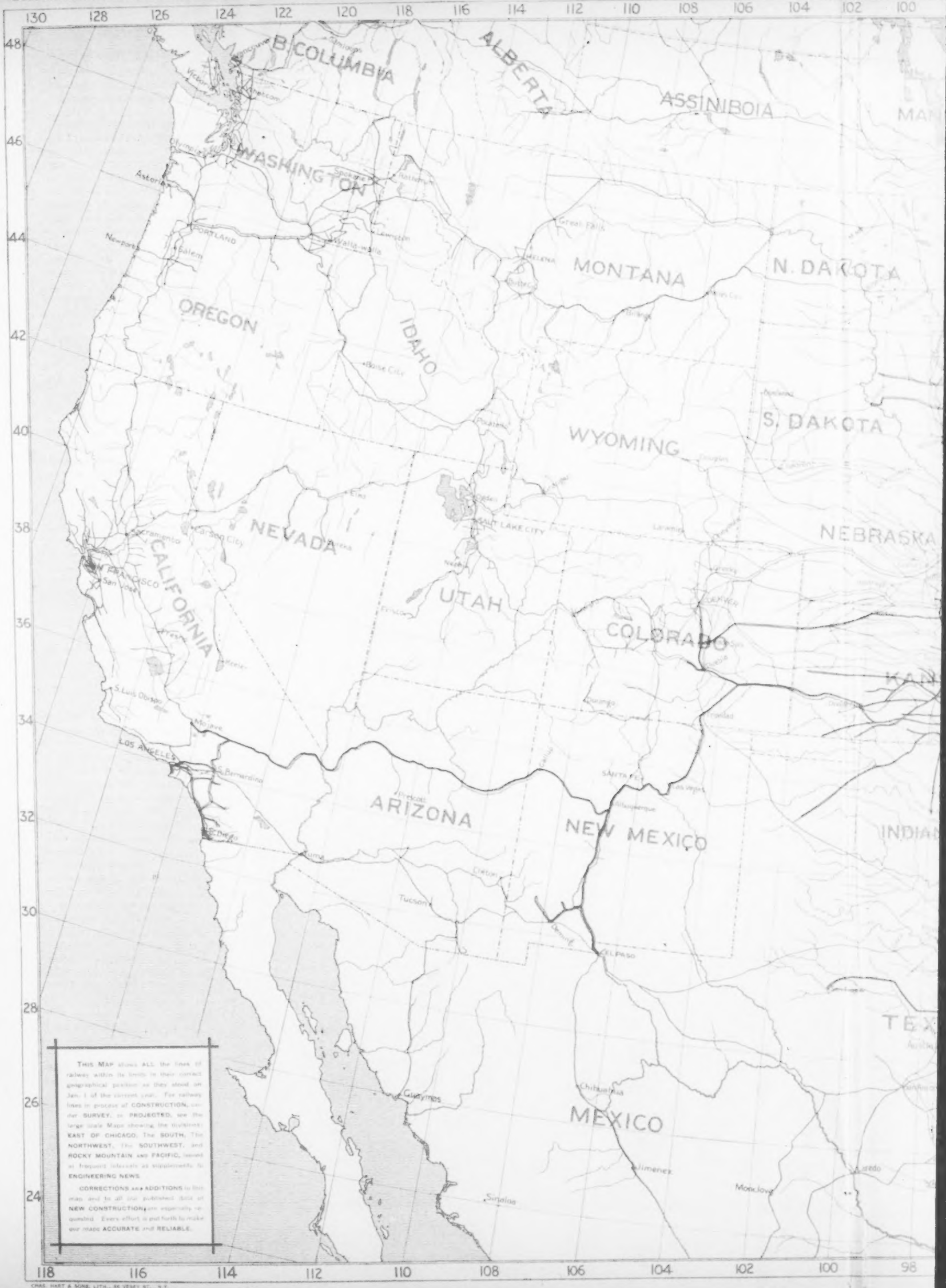
SINCE the above article was written we learn that the following petition is being actively circulated and generally signed:

The undersigned architects and engineers hereby certify that it is the common practice in building to make a distinction in the factor of safety to be used for cast iron on the one hand and for wrought iron and steel on the other hand; that the reliability of these materials respectively is as near as may be judged, as 3 is to 5; that for cast iron we consider one-fifth of the breaking load to be the safe load to be imposed on a structural piece, while in wrought iron and steel the safe load is one-third of the breaking load; that a building law should prescribe these factors of safety as the least admissible limit (no less than 3 and 5 respectively), granting a reasonable discretion to the Superintendent of Buildings to increase these factors of safety in special cases, inasmuch as sound and efficient buildings cannot be secured by a fixed law in this respect.

The wording of this petition is hardly such as we should have chosen, but there will be no dispute among engineers that it understates rather than overstates the degree of difference between cast and wrought iron in respect to proper factor of safety. The ratio of 3 to 6 or 9 would be much more nearly in accordance with the requirements of equal safety, than the ratio of 3 to 5. In fact the hour cometh and now is when the use of cast iron for ordinary columns in high buildings ought to be absolutely prohibited, as it is by general consent in bridge work.

THE unloading plant for gravel trains described in our last issue (p. 366) has a decided and notable advantage not noted in our article, but to which our attention has been called by Mr. A. J. SWIFT, Chief Engineer of the Delaware & Hudson Canal Co., on whose railway the plant has been in use. By keeping the train in motion, either fast or slow as desired, and keeping the plow moving at the same time, material can be deposited in any quantity desired per foot of track. Thus, if an ordinary train of 60,000-lb. flat-cars is used, and is kept stationary while being unloaded, the deposit is at the rate of about ¼ cu. yd. per ft. of track; but if it requires 2 minutes to "plow" the train, and at the same time the engine pulls ahead one train-length in 2 minutes, only ¼ cu. yd. per ft. is deposited, and so on. On the other hand, if it is desired to deposit a whole trainload in one car length, as at a washout or trestle, it can be done by backing the train as fast as the plow moves forward. The trains unloaded by this apparatus by contractors Drake & Stratton, on this line, average 20 cars, instead of occasionally reaching 16, as mentioned in our article.

We must confess that this feature of the plan did not occur to us in examining the plant, which seems to be otherwise a pretty useful improvement. But the ability to put the material exactly where it is wanted is a unique and evident advantage which will be frequently availed of in service and save a good deal of both time and labor. For filling a washout, for example, or a slide from a bank, this power of adjustment to requirements should prove highly useful.



THIS MAP shows ALL the lines of railway within its limits in their correct geographical position as they stood on Jan. 1 of the current year. For railway lines in process of CONSTRUCTION, under SURVEY, or PROJECTED, see the large scale Maps showing the divisions: EAST OF CHICAGO, The SOUTH, The NORTHWEST, The SOUTHWEST, and ROCKY MOUNTAIN AND PACIFIC, issued at frequent intervals as supplements to ENGINEERING NEWS.

CORRECTIONS AND ADDITIONS to this map and to all our published data of NEW CONSTRUCTION are especially requested. Every effort is put forth to make our maps ACCURATE and RELIABLE.

CHAS. HART & SONS, LITH., 86 VESEY ST., N.Y.

THE TOTAL NUMBER OF FREIGHT CARS IN THE UNITED STATES IN DECEMBER 1889, WAS 1,060,000. THE TOTAL NUMBER EQUIPPED WITH MASTER CAR BUILDERS' COUPLERS AT THAT TIME, WAS 48,805, OR ABOUT 4 5/10 PER CENT. OF THE TOTAL.

102 100 98 96 94 92 90 88 86 84 82 80 78 76 74 72

MANITOBA

ONTARIO

QUE

MINNESOTA

WISCONSIN

MICHIGAN

IOWA

NEBRASKA

ILLINOIS

INDIANA

OHIO

PENNA.

W. VA.

KANSAS

MISSOURI

KENTUCKY

VIRGINIA

TENNESSEE

N. CAROLINA

S. CAROLINA

INDIAN TER.

ARKANSAS

MISSISSIPPI

GEORGIA

ALABAMA

TEXAS

FLORIDA

Milwaukee

CHICAGO

Toledo

Detroit

Toronto

Hamilton

Buffalo

Cleveland

Pittsburg

Wheeling

Columbus

Cincinnati

Indianapolis

Louisville

Nashville

Memphis

Atlanta

Charleston

Savannah

Jacksonville

Mobile

New Orleans

Galveston

Houston

Austin

San Antonio

Waco

Brownsville

Laredo

Wilmington

Norfolk

Bay City

Grand Rapids

Kalamazoo

Peoria

Quincy

Springfield

Decatur

Terre Haute

Evansville

Chattanooga

Knoxville

Macon

Augusta

Brunswick

Waycross

Tallahassee

Ocala

Tampa

St. Augustine

Meridian

Vicksburg

Shreveport

Little Rock

Fort Smith

Texarkana

Dallas

Fort Worth

Denison

Sherman

Wichita

Topeka

Atchison

St. Joseph

Kansas City

St. Louis

Cairo

Paducah

Hannibal

Keokuk

Burlington

Davenport

Rock Island

Clinton

Dubuque

Winona

La Crosse

Green Bay

Oshkosh

Fond du Lac

Manitowoc

Sheboygan

Racine

Kenosha

Duluth

St. Paul

Minneapolis

Fargo

Grand Forks

Devils Lake

Jamestown

Aberdeen

Watertown

Huron

Sioux Falls

Yankton

Sioux City

Council Bluffs

Omaha

Lincoln

Hastings

Grand Island

Kearney

North Platte

Valentine

Alliance

Chadron

Crawford

Rushville

Gordon

Ainsworth

Norfolk

Fremont

Blair

Tekamah

Missouri Valley

Harlan

Atlantic

Creston

Red Oak

Shenandoah

Clarinda

Nebraska City

Plattsmouth

Beatrice

Fairbury

Hebron

Superior

Red Cloud

Franklin

Holdrege

Oxford

Cambridge

McCook

Benkelman

Trinidad

Las Animas

Lamar

Holly

Granada

Pueblo

Colorado Springs

Denver

Cheyenne

Laramie

Rawlins

Green River

Evanston

Ogden

Salt Lake City

Provo

Helena

Butte

Missoula

Spokane

Walla Walla

Portland

Tacoma

Seattle

Everett

Bellingham

Vancouver

Victoria

Calgary

Edmonton

Regina

Moose Jaw

Medicine Hat

Winnipeg

Brandon

Portage la Prairie

Prince Albert

Saskatoon

Swift Current

Moosomin

Yorkton

Estevan

Weyburn

Minot

Bismarck

Mandan

Dickinson

Glendive

Miles City

Billings

Livingston

Bozeman

Great Falls

Havre

Shelby

Kalispell

Whitefish

Libby

Sandpoint

Wallace

Kellogg

Coeur d'Alene

Lewiston

Pendleton

The Dalles

Hood River

Astoria

Salem

Albany

Eugene

Roseburg

Ashland

Klamath Falls

Medford

Grants Pass

Crescent City

Eureka

Fort Bragg

Ukiah

Santa Rosa

Petaluma

San Rafael

San Francisco

Oakland

Berkeley

Alameda

San Leandro

Hayward

Niles

San Jose

Santa Cruz

Watsonville

Salinas

Monterey

Pacific Grove

Carmel

Paso Robles

San Luis Obispo

Santa Barbara

Ventura

Los Angeles

Pasadena

Glendale

Burbank

San Fernando

Santa Monica

Long Beach

Santa Ana

Anaheim

Orange

Riverside

San Bernardino

Redlands

Colton

Pomona

Ontario

Upland

Claremont

San Dimas

Azusa

Covina

Monrovia

Arcadia

Alhambra

San Gabriel

El Monte

Whittier

La Habra

Fullerton

Buena Park

Santa Fe Springs

Norwalk

Downey

Compton

Inglewood

Redondo

Hawthorne

Gardena

Torrance

San Pedro

Wilmington

Huntington Park

South Gate

Bell

Maywood

Vernon

Commerce

Montebello

Pico

Rivera

Whittier

La Habra

Fullerton

Buena Park

Santa Fe Springs

Norwalk

Downey

Compton

Inglewood

Redondo

Hawthorne

Gardena

Torrance

San Pedro

Wilmington

Huntington Park

South Gate

Bell

Maywood

Vernon

Commerce

Montebello

Pico

Rivera

0 100 200 300 400 500

150 MILES TO 1 INCH

98 96 94 92 90 88 86 84 82 80 7

ENGINEERI
SERIES

UNIT

RAILWAYS WHI
EQUIPPING

Master Car Bu

Rai

Rai

This map shows ALL
their correct geographi

COPYRIGHTED

ENGINEERING NEWS
SERIES OF MAPS: No. 33.

UNITED STATES.

WAYS WHICH IN DECEMBER, 1889, WERE
EQUIPPING NEW FREIGHT CARS WITH
Car Builders' Automatic Couplers.

Railways which in December, 1889, were equipping ALL NEW FREIGHT CARS with Master Car Builders' Couplers. Total, 19,465 miles.

Railways which in December, 1889, were equipping ALL NEW FREIGHT CARS OF SPECIAL CLASSES with Master Car Builders' Couplers. Total, 16,420 Miles.

shows ALL the lines of railway, within its limits, in ct geographical position, as they stood on Jan. 1, 1891.

THIS MAP shows ALL the lines of railway within its limits in their correct geographical position as they stood on Jan. 1 of the current year. For railway lines in process of CONSTRUCTION, under SURVEY, or PROJECTED, see the large scale Maps showing the divisions EAST OF CHICAGO, The SOUTH, The NORTHWEST, The SOUTHWEST, and ROCKY MOUNTAIN AND PACIFIC, issued at frequent intervals as supplements to ENGINEERING NEWS.

CORRECTIONS AND ADDITIONS to this map and to all our published data of NEW CONSTRUCTION are especially requested. Every effort is put forth to make our maps ACCURATE and RELIABLE.

COPYRIGHTED 1891 BY ENGINEERING NEWS PUBLISHING CO.

CHAS. HART & SONS, LITH., 35 VESEY ST., N.Y.

THE ESTIMATED TOTAL NUMBER OF FREIGHT CARS IN THE UNITE
STATES ON JANUARY 1, 1891, WAS 1,150,000. OF THESE 49 PER CENT. ARE
CONTROLLED BY COMPANIES APPLYING MASTER CAR BUILDERS' AUTOMATI
COUPLERS TO ALL NEW FREIGHT CARS, AND 12 PER CENT. BY COMPANIE
APPLYING MASTER CAR BUILDERS' AUTOMATIC COUPLERS TO ALL NE
FREIGHT CARS OF CERTAIN CLASSES. TOTAL, 61 PER CENT.

THE TOTAL NUMBER OF FREIGHT CARS EQUIPPED WITH MASTER CA
BUILDERS' AUTOMATIC COUPLERS ON JANUARY 1, 1891, WAS 102,347
OR ABOUT 8 9/10 PER CENT. OF THE TOTAL.

120 118 116 114 112 110 108 106 104 102 100 98 96 94 92 90 88 86 84

ALBERTA
ASSINIBOIA
MANITOBA
MONTANA
N. DAKOTA
MINNESOTA
MICHIGAN
IDAHO
WYOMING
S. DAKOTA
WISCONSIN
NEBRASKA
IOWA
UTAH
COLORADO
ILLINOIS
KANSAS
MISSOURI
ARIZONA
NEW MEXICO
INDIAN TER.
ARKANSAS
TEXAS
MEXICO

110 108 106 104 102 100 98 96 94 92 90 88

84 82 80 78 76 74 72 70 68 66

THE UNITED
CENT. ARE
AUTOMATIC
Y COMPANIES
ALL NEW
R CENT.
MASTER CAR
102,347

48 46 44 42 40 38 36 34 32 30 28 26 24

QUEBEC
MAINE
ONTARIO
VT
N.H.
MASS
BOSTON
NEW YORK
PHILADELPHIA
W. VA.
VIRGINIA
KENTUCKY
TENNESSEE
N. CAROLINA
S. CAROLINA
GEORGIA
ALABAMA
FLORIDA
CHARLESTON
Savannah
Brunswick
JACKSONVILLE
Tallahassee
Tampa
Wilmington
Norfolk
Toronto
Hamilton
Buffalo
Cleveland
Toledo
Detroit
Chicago
Indianapolis
Louisville
Nashville
Memphis
Atlanta
Birmingham
Montgomery
Mobile
New Orleans
Pensacola
Jacksonville

300 400 500
ES TO 1 INCH

ENGINEERING NEWS
SERIES OF MAPS: No 34.

UNITED STATES.

RAILWAYS EQUIPPING NEW FREIGHT CARS
WITH
Master Car Builders' Automatic Couplers.

Railways reporting to Engineering News, that on January 1, 1891, they were equipping ALL NEW FREIGHT CARS with Master Car Builders' Couplers. Total, 53,583 miles, controlling 567,433 cars.

Railways reporting to Engineering News, that on January 1, 1891, they were equipping ALL NEW FREIGHT CARS OF CERTAIN CLASSES, with Master Car Builders' Couplers. Total, 18,228 miles, controlling 135,010 cars.

This map shows ALL the lines of railway, within its limits, in their correct geographical position, as they stood on Jan. 1, 1891.

88 86 84 82 80 78 76 74

COPYRIGHTED 1891 BY ENGINEERING NEWS PUBLISHING CO.

Why the Equipment of Freight Cars with Automatic Couplers Should be Hastened.

In view of the statistics given in this issue concerning the use of the Master Car Builders' type of automatic coupler on freight cars, there is little room left for any reasonable man to doubt that a few years will see practically all the freight cars of the country equipped with these couplers, and the hundreds of deaths and thousands of injuries which have annually resulted from the use of the antiquated link-and-pin coupling will no longer occur. Our statistics, be it noted, are from *official reports*, made directly to us by officers of the several companies, whose interest and courtesy in giving this information we desire to acknowledge. These reports showing that the M. C. B. coupler is applied to new cars, have been received by this journal from companies controlling over **70,000** miles of railway and over **700,000** freight cars. The total number of cars equipped with the coupler up to Jan. 1, 1891 was over **102,000**, or nearly 9 per cent. of the freight rolling stock of the United States. We have also shown elsewhere that the progress in the reform has been steadily and continually accelerated; in fact, more than half the cars having the couplers at the beginning of this year were equipped during 1890. Since the beginning of the present year we have positive knowledge of the placing of orders for the equipment of over 21,000 cars with two coupler manufacturers; and making a fair allowance for what other manufacturers are doing, it is clear that 1891 promises a substantial increase over 1890 in the number of cars equipped.

Considering it settled, then, that the M. C. B. automatic coupler is to be the coupler of the future, we wish to call attention to some very weighty and (we suspect) little understood and appreciated reasons for equipping all the cars in the country with the coupler as rapidly as possible.

The benefits derived from automatic couplers are of three classes: first, the prevention of accidents to employees in coupling cars and accidents to trains due to the breaking of couplings; secondly, the money saving due to economy of maintenance of the M. C. B. coupling compared with the link and pin, which we believe will prove to be very considerable, despite the preposterous misstatements which continue to emanate from New England; and, thirdly, economy in handling trains, which will be possible when the couplers and air brakes come into general use, which latter we showed to be an immensely important consideration in our issue of Dec. 21, 1889.

Now it is self-evident that the gain in freight cars equipped with automatic couplings is only secured when two cars with automatic couplers are brought together. When an automatic coupler car is attached to a car with the old-style drawhead, the coupling must be made by hand with the link and pin, and there is little or no gain in safety nor in any other respect.

But in order to do away with the general coupling of freight cars by hand, with its attendant dangers, *all* the freight cars in the United States must be equipped with automatic couplers. It is well to congratulate ourselves upon the fact that one-tenth of the freight cars in the country are well equipped with automatic couplers. At the same time it should be understood that not until we progress much farther will we gain any substantial benefit from the money expended; and not until the reform is practically finished will the gain which it promises be general.

The correctness of this statement is easily proved. Let us suppose that cars, with automatic and with link-and-pin couplings, do equal service, so that a car of one class is coupled as often as a car of the other. Then at the present time, when *one-tenth* the cars in service have automatic couplers, *only one coupling in a hundred* is made between two cars with automatic couplers. When even *one-fourth* the cars have automatic couplers, only *one-sixteenth* of the couplings will be between automatic coupler cars. Even when *one-half* the cars are equipped, only *one-fourth* the couplings made will be between automatic coupler cars. Thereafter the gain begins (and only then begins) to be quite rapid.

It may not be plain at first why this is so; for at first glance it seems as if when one-fourth the cars were equipped with automatic couplers one-fourth the couplings made would be between automatic coupler cars. An example will show why this view of the case is incorrect. Suppose that 400 cars are run promiscuously together and separate from all other cars, and that, as all do equal service, the average number of couplings made in a given time is the same for each car.

Of these cars suppose that one-fourth, or 100 cars, have automatic couplers and the remainder have link-and-pin drawbars. Then each of the 300 link-and-pin cars in making a coupling stands 3 chances out of 4 of meeting a car of its own class, and 1 chance out of 4 of meeting one of the automatic coupler cars. Similarly, each one of the 100 automatic coupler cars has chances of 1 to 4 of meeting one of its own class and of 3 to 4 of meeting a car with a link-and-pin coupler. Hence in every 400 couplings there will be:

$300 \times \frac{3}{4} = 225$ couplings between link-and-pin cars;

$300 \times \frac{1}{4} = 75$ *plus* $100 \times \frac{3}{4} = 75$, or 150 in all, couplings between link-and-pin cars and automatic coupler cars, and

$100 \times \frac{1}{4} = 25$ couplings between automatic coupler cars. Therefore, when one-fourth the cars are equipped with automatic couplers, only one-sixteenth the couplings will be made automatically. The following will be the proportion of couplings made automatically with different proportions of the cars equipped with automatic couplers:

Proportion of freight rolling stock equipped with automatic couplers.	Proportion of couplings made automatically.
One-fourth	One-sixteenth
One-half	One-fourth
Three-fourths	Nine-sixteenths
Seven eighths	Forty-nine sixty-fourths

In general, to express the same facts mathematically, if in any lot of cars we let a = either the number or the percentage of cars equipped with one kind of coupler, and b = the number or percentage of cars equipped with another kind, the total number of cars, or of the two percentages being $a + b$, then will the successive terms of the *square* of $a + b$, viz.:

$$a^2 + 2\,a\,b + b^2$$

give in order (1) the number or percentage of couplings of a cars with a cars, (2) the number or percentage of couplings for a cars with b cars, and (3) the same for b cars with b cars, from which expression it is evident that the frequency with which the new coupling couples with itself increases as the square of the number in service, and hence is not great till the number of cars so equipped is more than half.

The following shows the number of each class of coupling made as thus determined, for each 10 per cent. of cars equipped with automatic couplers:

Percentage of cars equipped with automatic couplers.	*Percentage of couplings between cars.* Made by hand. Between link-and-pin cars.	Made by hand. Between link-and-pin cars and automatic coupler cars.	Made automatically. Between automatic coupler cars.
10	81	18	1
20	64	32	4
30	49	42	9
40	36	48	16
50	25	50	25
60	16	48	36
70	9	42	49
80	4	32	64
90	1	18	81

The showing made by this table demands careful consideration by every railway manager and by all interested in reducing the terrible roll of victims killed and maimed by the link-and-pin coupler. The benefits promised by the use of automatic couplers are not illusory. They are real and substantial, and, as has been fully shown, they are sufficient to pay for the introduction of the M. C. B. automatic coupler aside from the saving in employees' lives and limbs. To secure them, however, within any reasonable time, *all* the railways of the country must set to work in earnest to equip their cars with the new couplers. Not only all new equipment should receive the couplers, but every car coming into the shop for general repairs, and indeed every car which can be got at to change its drawbars without undue expense or interference with its use.

At present, and until more than *five times* as many cars as now are equipped, inexorable mathematical laws require that the "cross-couplings" of new with old, with all their accompanying dangers and disadvantages, shall increase instead of decrease with each new car equipped. This being so, the extreme importance of hastening the equipment of cars is manifest on a glance at column three of the above table, which shows that from the time 30 per cent. of the cars are equipped to the time 70 per cent. of the cars are equipped nearly half the couplings made will be of the class generally supposed to be the most dangerous of all, and, on the whole, we believe, with good reason.

We are aware that our assumption that automatic coupler cars and link-and-pin cars perform the same service is not quite correct. At present the former are chiefly used in line service; but, while these make a greater mileage than local cars, it is doubtful if they make as many couplings in a given time as the cars used for local work. It is also true, of course, that the percentage of cars equipped with automatic couplers varies greatly in different parts of the country. Some roads may have as many as 20 per cent. or more of the cars passing over their lines equipped with automatic couplers. For this percentage of cars equipped the percentage of automatic couplings made is seen by the table to be 4, or 1 in 25; but the present average for the whole country, with a tenth of all its cars equipped, is an insignificant 1 per cent., which hardly gives the trainmen a chance to learn how to do it easily.

Another thing which somewhat increases the proportion of couplings made automatically is the fact that most cars which have automatic couplers have also the air-brake, and there is a tendency to keep these cars together. Of course, if all cars with automatic couplers are kept by themselves, the percentage of couplings made automatically will be the same as the percentage of cars equipped. This consideration loses much of its force, however, when it is remembered that the air-brake cars have to be considerably scattered among other cars when in the yards. In general, therefore, the results shown by the table hold good; and the fact must be faced that the equipment of cars with automatic couplers must be materially hastened to avoid serious loss to the railways, and a perpetuation and possible increase of car coupling accidents for many years to come.

According to "Poor's Manual" the freight equipment of the railways of the United States has had an average increase during the past five years of 52,353 cars per annum. This growth is being constantly accelerated, and it hardly admits of doubt that the 53,500 cars equipped with automatic couplers during 1890 did not equal the number of cars added to the freight equipment of the country during that year. In other words, instead of the number of link-and-pin-coupler cars in the country being reduced, it is actually being increased at the present time.

Our returns show over 102,000 cars equipped with automatic coupler on Jan. 1, 1891. By this time the number is probably at least 120,000. These couplers represent an investment of $3,000,000, which is little if any more, to be sure, than would have been necessary to equip the cars with the old-style coupler, but it is a comparatively unproductive investment which can only be made to give a due return by

pushing the equipment of still more cars with all possible speed. Each road which has already made a start has a very strong inducement to push on its equipment still more rapidly, and also, as the above tables will at once reveal, has a direct and strong interest in compelling the roads which have as yet done nothing to delay no longer, but be up and doing. Supposing half the roads in the country equip all their stock and the other half do nothing? Except that a large proportion of the cars stay on the home roads, the last state of the progressive roads would be worse than the first, owing solely to the faults of others.

Moreover, it is to be borne in mind that in this matter the railways are not likely to have much longer the privilege of delaying action.

A committee was appointed at the annual convention of state railway commissions with the Interstate Commerce Commission to secure Congressional action in regard to safety appliances. This committee, of which Hon. GEO. G. CROCKER, of Massachusetts, is the Chairman, meets at Washington on the date of the present issue of ENGINEERING NEWS.

The bills before the last Congress for the compulsory use of automatic freight brakes and couplers failed of passage, we are informed, not from opposition, but from the pressure of other business at the end of the session. We have private assurances, which we believe to be trustworthy, that the all but unanimous feeling of Congress was that the bill should be passed. In the next Congress the combined influence of the railway employees' organizations and the state and interstate railway commissions, which will be exerted in favor of the bill, makes its passage extremely probable.

It is to be remembered that the great obstacle to legislation on this matter heretofore has been the fact that no one could say what coupler should be adopted as the standard. Thanks to the wise action of the Master Car Builders' Association, seconded by progressive railway managers, legislation is no longer barred by this obstacle. Opposition to any Congressional legislation on safety appliances will doubtless be made by the railways. There is too much Farmers' Alliance timber in that body, however, to make it likely that such opposition would have much effect in a case where reason and justice are all against them. It seems plainly evident that the railways which have already invested $3,000,000 in automatic couplers (which includes a large majority of the powerful corporations) will be benefited by compulsory legislation, since it will compel their delinquent neighbors to undertake the reform. For this reason it would seem to be the wisest course for the influential railways, which have begun the reform, to aid in the preparation of the bill, see that its provisions are such as will best secure the desired object, and exert their influence to secure its passage.

The Area and Population of the Great Drainage Basins of the United States.

Whether or not the Census of 1890 be justly open to the charge of incompleteness—and the indications are pretty strong that it is—it cannot be denied that a great deal of prompt and effective work is being done in compiling and presenting its results, and that in this respect the 1890 census compares most favorably with all its predecessors. In part, no doubt, this unusual promptness is due to the ingenious counting and calculating machine which has been used in compiling this census for the first time; but it is but just to give the bureau credit for what it is doing, however the result is achieved.

No less than 47 successive bulletins have been already issued, covering a large part of the more important details of the census. The 47th bulletin, which lies before us, is on the "Distribution of Population by Drainage Basins," and is one of the most curious and interesting of them all, if not one of the most valuable. The same facts have never before been compiled in anything like as complete shape. The bulletin gives for every considerable drainage basin in the United States, some 100 in all, the area in square miles, and the total population and population per square mile for 1870, 1880 and 1890, thus enabling the movements and tendencies of population to be studied on a much more rational basis than the lines of merely political divisions permit.

On the two grand divisions, draining into the Atlantic or into the Pacific, the record stands as follows:

	Area in sq. miles.	Pop., 1 = 1,000,000. 1870.	1880.	1890.	Pop. per sq. mile. 1870.	1880.	1890.
Into Atlantic	2,178,210	37.71	48 71	60.22	17.3	22.4	27.6
Into Pacific..	619,240	0.73	1.24	2.15	1.2	2.0	3.5
Into Salt Lake basin.	228,150	0.13	0.21	0.26	0.5	0.9	1.1
Total.....	3,025,600	38.57	50 16	62.63	12.7	16.6	20.7

The per cent. of the Atlantic population, which was 97.8 in 1870, has only fallen to 96.2 in 1890, indicating that our great Pacific domain still cuts a larger figure in imagination than it does in reality, since not only is the aggregate small, but it does not tend to increase with very noticeable rapidity. Thus the population of the Salt Lake basin has only doubled in 20 years, and the Pacific Slope has less than tripled, at which rate it will take a long time for it to reach so much as a tenth of our total population.

The drainage into the Atlantic, varying somewhat from the census classification, may be subdivided as follows:

	Area in sq. miles.	Pop., 1 = 1,000,000. 1870.	1880.	1890.
Mississippi River	1,240,039	16.33	21.78	27.41
Other Gulf rivers	485,941	3.03	4.39	5.58
Total Gulf of Mex	1,725,980	19.36	26.17	32.99
Great lakes	175,340	4.23	5.38	7.01
Other Atl. coast	276,890	14.12	17.16	20.22
Total Atl. coast	452,230	18.35	22.54	27.23
Total of Atl. and Gulf	2,178,210	37.71	48.71	60.22
	Area in sq. miles.	Pop. per sq. mile. 1870.	1880.	1890.
Mississippi River	1,240,039	13.2	17.6	22.1
Other Gulf rivers	485,941	6.2	9.1	11.5
Total Gulf of Mex	1,725,980	11 2	15.2	19.1
Great lakes	175,340	24.1	30.7	40.0
Other Atl. coast	276,890	50.9	61.8	73.1
Total Atl. coast	450,230	40.6	49 9	60.2
Total of Atl'tic and Gulf.	2,178,210	17.3	22.4	27.6

The great Mississippi River Basin, including about half the habitable territory of the United States, had 42¼ per cent. of our whole population in 1870 and 43¼ per cent. in 1890, its increase of population having been 68 per cent. in 20 years, against 48.3 per cent. in the total Atlantic-coast drainage basin. In absolute increase, 11.08 millions settled in the whole Mississippi Valley, against 8.88 millions in the area draining into the Atlantic coast.

Included in the Atlantic coast area, however, is the basin of the Great Lakes, which is in popular thought associated more with the Mississippi basins than with the Atlantic coast, and not unreasonably. It is a basin of much more limited area than is generally appreciated, however, the divide lying everywhere quite close to the Lakes. Including this basin with the Mississippi the comparison with the Atlantic coast stands as follows:

	Area in sq. miles.	Pop., 1 = 1,000,000. 1870.	1880.	1890.	Pop. per sq. mile 1870.	1880.	1890.
Miss. R. and Gt. Lakes	1,415,379	20.56	27.16	34.42	14.6	19.2	24.3
Atlantic Coast proper	276,890	14.12	17.16	20.22	50.9	61.8	73.1

The Mississippi and lake basin together has increased in 20 years 13.86 millions, or 67 per cent., while the residue of the Atlantic Coast has increased 8.1 millions, or 57½ per cent.

It is obvious from these figures that the rush of population westward can hardly be considered a torrent. There are strong forces at work tending to maintain and increase the Eastern population, as well as the more generally appreciated forces tending to drive it westward. The Lake Basin itself, albeit Chicago and several other booming cities are in it, has only increased in population 2.78 millions, or 63 per cent., in the past 20 years, which is less than the average of the Mississippi Valley, and by no means impressive in aggregate, considering that the great development of the Lake Superior region is included in this aggregate.

But on the other hand, the great Hudson River Basin, according to this bulletin, has increased vastly less, from 71.8 to only 81.9 inhabitants, per square mile, or 14¼ per cent. New York City and Jersey City do not appear to be included at all in this basin, for its 1890 population is given as only 1,094,126, which the upper drainage basin of the Hudson (extending as it does as far west as Rome and Utica) ought to account for without any aid from the metropolis. Almost half of New York City and all of Jersey City drain into what is called the Hudson; but it is true, on the other hand, that the Hudson at its mouth is little more than an arm of the sea. It will surprise many to learn that the Delaware River Basin is credited with 2½ times the population, and nearly 3 times the population per square mile (213.2, against 81.9) of the Hudson Basin. Perhaps the census office is a little down on New York, and took this method of humbling its pride.

The great Ohio River Basin (included in which are the Tennessee and Cumberland) includes 201,720 sq. miles and 10,985,876 population, or over one-sixth of the total population of the United States, and 40 per cent. of the population of the Mississippi Valley, or one-sixth of the area of the latter. Its average population per square mile is 54.5, which is pretty evenly distributed over its whole area. This is a considerably denser population than that of the Great Lakes basin, which is only 40.0 per sq. mile, that of Lake Michigan only being 54 7 per sq. mile. In comparison with these, the most densely populated valley on the Pacific Coast, the Willamette Valley, in Oregon, has only 11.1 per sq. mile, and the (much larger) valley of the Sacramento only 6 4 per sq. mile.

The valleys, which are given as having an average population of over 100 per sq. mile, are only the Delaware (213.2), Housatonic (130.2), Merrimack (126.8), Lake Erie (126.7) and Middle Atlantic coast, in which alone New York and Brooklyn appear, 138.3. The Hudson River, Lake Ontario and Miami River are the only other valleys which have over 80 per sq. mile.

CORRESPONDENCE.

Standpipe Failure—Correction—A Trestle Failure.

TEMPLE, Tex., April 15, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR:—Noting the publication of my letter of Nov. 1, 1890, relative to the stand-pipe failure at this place, I would respectfully call your attention to a typographical error in crediting the letter to W. D. PAIRCE instead of W. D. PENCE.

We had a serious bridge accident last night, caused by a small highway bridge knocking several bents out of a high frame trestle two miles from Temple. Local heavy rains, almost a cloudburst, caused the accident, and the unfortunate part of it is the fact that a freight train got an engine and 9 cars through the bridge, the engineman and a brakeman being killed. Will complete my examination of the matter to-morrow, and in case items worthy of your columns develop, I will forward them promptly. I give you the above facts in refutation of possible press notices that the structure failed from the force of water only. The sills had been anchored securely to bedrock and the posts securely fastened to the sills.

Yours truly, W. D. PENCE.

The Pegram "Radial" Truss.

ST. LOUIS, Mo., April 21, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Mr. FREDERICK H. SMITH'S letter, published in your issue of April 11, erroneously refers to the truss which I have proposed as a "radial" truss, and implies

that it is the development of an idea advanced by him twenty years ago.

If Mr. SMITH were correct, and I had been indebted to him for the smallest suggestion, common decency would demand my acknowledgement; but where he has neglected nine-tenths of his duty to the profession involved in the development, demonstration and introduction of his invention, for which he had unusual ability and advantages, and I was embarrassed and injured by a reference to his hidden treasure by the Patent Office, common decency demands an opposite course.

It is unfortunate that Mr. SMITH should have applied the term "radial" to probably the only truss which is *not* usually "radial." If he had called the Whipple, Post or Warren trusses "radial," he would have been strictly correct; their posts are parallel and we are taught that all parallel lines radiate from infinity. The only feature of our trusses, that the posts are as near vertical as possible in the middle, and increase in inclination toward the ends. The origin of my truss will be very apparent to any one who will read the patent papers.

Long before curved chord bridges, except bowstrings, had been used in this country, I made calculations of a curved chord truss with vertical posts. I was astonished to learn that the saving in cost through reduced weight, was absorbed by the more expensive shop work entailed by the greater variety of lengths, leaving the Whipple still in command of the field. I then simply imposed the conditions on the curved chord that obtain in the Whipple, viz.: Equal lengths of posts and chords respectively, which could only result in a gradual increase in inclination of the posts from center to ends. Other developments naturally followed. GEO. H. PEGRAM.

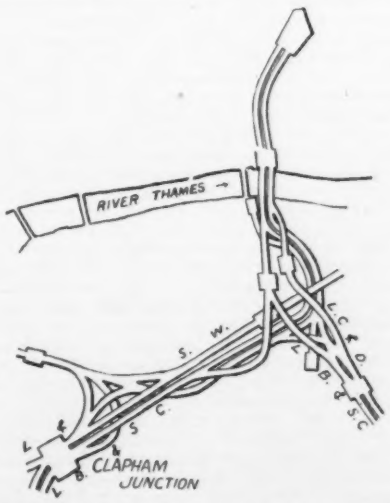
[It appears to us that both Mr. SMITH and Mr. PEGRAM take reasonable enough positions in this matter. Mr. SMITH is clearly within his right in pointing out that he originated somewhat similar or even identical ideas to Mr. PEGRAM'S many years ago. Mr. PEGRAM is clearly within his right in claiming that "merely conceiving an idea is not invention or discovery," in the sense of diminishing the just credit of a later and independent investigator, who is the first to put the idea into practical use on a considerable scale. By common consent in regard to all new devices of proven or possible merit the main credit is given to him who first reduces them to practical shape in a practical way, but every one who, at any prior date has conceived the same idea in a more or less inchoate state may reasonably claim and to receive such credit as he deserves therefor, without being considered to encroach upon, or reduce the credit of him who rediscovers and develops the idea on a practical scale. We cannot publish more on this subject.—EDITOR ENGINEERING NEWS.]

Railway Traffic Passing Clapham Junction, London.

SMITHVILLE, Ga., March 23, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Find attached a clipping from a newspaper, stating that 1,600 trains pass the Clapham Junction, London,



Sketch Showing Arrangement of Railway Tracks at Clapham Junction, London.

where the London & Southwestern and London, Brighton & South Coast railways cross, in 24 hours. If consistent, will you kindly give me, through the columns of ENGINEERING NEWS, what information you can on this subject, number of tracks used and whether these include suburban trains doing similar traffic to the "L" trains in New York City. Yours truly,

A. H. PORTER, Road Master.

[In Mr. SAMUEL REA'S "Railways Terminating in London" (ENGINEERING NEWS Publishing Co., $1.50) it is stated as to this junction:

Between Queen's Road and Clapham Junction stations there is a labyrinth of railways. It is said that more trains pass this latter station daily on the various lines of railways than at any other junction in the world. More than 1,200 trains pass this junction every 24 hours, 1,000 of these being signaled between 7 A. M. and 10 P. M., or 1,000 trains in 900 minutes, an average of one train every 54 seconds during 15 hours.

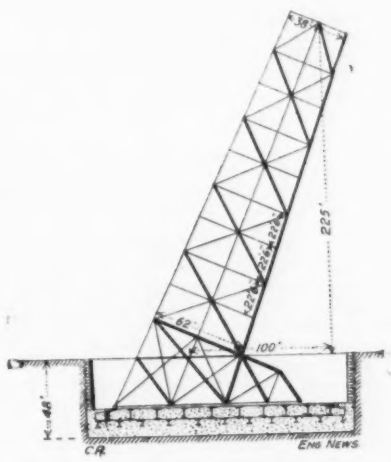
This is a greatly larger number than occurs anywhere in this country, and the discrepancy between 1,200 and 1,600 probably arises only from the fact that the one is the average and the other an occasional total. Clapham Junction, however, is rather an agglomeration of tracks and junctions of main and suburban lines than an ordinary junction, as the accompanying sketch map will make clear. The traffic consists chiefly of main-line and suburban passenger trains, with a certain amount of freight traffic.—ED. ENG. NEWS.]

A Proposed Cantilever or Leaning Tower at the Columbian Exposition.

CHICAGO, Ill., March 25, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: This projected engineering novelty is a massive tower, having an elevation of 225 ft., about 70 ft. square, and leaning 100 ft. from the perpendicular. The entire



Proposed Leaning Tower for Columbian Exposition at Chicago.

structure is of metal, principally steel, weighing about 500 tons above the foundation, and of a novel cantilever construction that meets all requirements of stability. It will be built to safely sustain a load of 160,000 lbs. on the floor of the top story.

The framework is of steel truss construction, forming a cantilever of enormous strength and rigidity, which combines for support a substructure of metal. The accompanying diagram, showing truss and foundation, will readily explain the principle of construction. It will be observed that the tower frame and substructure, as a whole, resembles the letter L, of which the lower part acts as a foot or offset to take the strain due to the leaning of the superstructure.

The depth of substructure is 48 ft., the area 165 × 115 ft. The construction of the foundation is chiefly of plate-riveted iron girder work embedded in concrete, which forms a solid bed about 18 ft. deep. This girder-concrete foundation has the characteristic of being continuous in structure and rigid throughout, and is especially designed for building on yielding substrata, such as the deep clay of Chicago. On the girder work there are bolted steel-bearing plates, and on these plates the foot of the cantilever rests. This foot at the left side will be attached to the metal parts of the bed by large steel pins and eye-bars, but these connections will not be brought into play unless the tower is heavily loaded.

In the superstructure 3 lines of trusses constitute the main supports; 2 form sides of the tower, the third has a middle position, and a lateral truss system braces them together. Pin connections are used for truss members. The walls of the tower are comparatively light, being simply a framing of small-sized angle iron attached to the trusswork and having a facing of embossed sheet metal. The exterior will be painted a dark terra-cotta color.

Electric-hoist elevators and easy stairways lead from the entrances to the upper stories. Above the first story there are 5 floors. They are inclined and consist of series of broad steps extending across the tower. Numerous windows light the interior, balconies provide interesting outlooks for visitors, and at the top of tower an extensive view of the surroundings and a mid-air realization may be had. A spacious buffet serving light refreshments will be in the top story, and about midway will be the Tower Curiosity Shop. The visitor can also reach the foundation and examine its construction

At Bologna, Italy, there is an old tower called the Garisenda. It is 130 ft. high, 18 ft. square, and 8 ft. out of plumb. A better-known tower of this character is the campanile of Pisa. It was built in the twelfth century, and is a stone structure, 50 ft. in diameter, 179 ft. high, and leaning 13 ft. out of perpendicular. The leaning of this tower was due to a poor foundation while building; the tower had reached but one-third of its intended height when the foundation on one side began to sink and incline the structure. The masonry was then strengthened with iron clamps, which have kept the work intact.

The cantilever or L tower will be the greatest leaning structure in the world and will be unique in many particulars. Besides affording an attractive sight for visitors, it will be a novel exhibit of the application of metal to all building purposes. It will take 8 months to build this structure, which includes shop work and erection. The cost will be about $500,000. J. B. HALPENNY.

The Kipton Accident, L. S. & M. S. Ry.

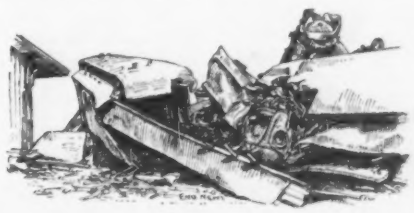
OBERLIN, O., April 20, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: There was a collision at Kipton Station, about 40 miles west of Cleveland, on the Southern division of the Lake Shore & Michigan Ry., on April 18, between the Toledo Express, No. 21, consisting of 3 baggage and express cars, 3 day coaches, 1 sleeper and 1 empty coach, 8 in all, and the New York Mail, No. 14 (upon which there is a heavy forfeiture in case of delay), consisting of 3 mail cars, 1 sleeper and 1 chair car, 5 in all.

The express had nearly made the station stop, while the mail was coming at full speed, which at this point is 45 miles per hour, when they met, resulting in the compression into a shapeless mass, 111 ft. long and 30 ft. wide at the center, of 2 mail cars, 2 locomotives and 3 baggage and express cars, and the instant death of 6 postal clerks and 2 engineers, with injury to 3 others, one a passenger and one a bystander.

Although the destruction of the cars and engines named above was so complete, none of the coaches of No. 21 left the track, and the chair car, sleeper and rear truck of the rear postal car remained on the track, the front truck of the latter being but slightly displaced.



The Wreck at Kipton, O., L. S. & M. S. Ry.

The station at Kipton is near the middle of a curve of about 1°, and about a half-mile long. On the inside of the curve is a sidetrack the whole length, and extending on to the west the same distance. One hundred feet west of the passenger depot, and on the inside of the sidetrack, is the freight depot, and about 200 ft. west of this is a crossing. The sidetrack from the crossing east was full of freight cars, and these with the freight depot cut off the engineman's view ahead except for a short distance.

No. 21 is due at Kipton at 4:19 and due to pass No. 14 at 4:52, which it does by pulling ahead to the crossing after discharging its passengers.

No. 14, with a few others, is given the right of track after all other passenger trains, including No. 21.

No. 21 was 5 minutes late at Oberlin, 4.6 miles east, and 3 minutes late at Kipton. The agent received an order and was in the act of turning the target against No. 14 when the collision occurred almost in front of his office.

Rumor has it, and with good grounds for credibility, that this order was to countermand one previously re-

ceived to meet at Oberlin, the order having been countermanded for No. 21 at Oberlin.

This is the second serious accident which has occurred on this spot within a few years. G.

[The moral of this occurrence is so obvious, if the circumstances are correctly stated, that we forbear to comment on it.—ED. ENG. NEWS.]

Riveted Steel Pipes *

The application of steel in the construction of water pipes is of comparatively recent date in Great Britain, and has developed a new and important industry, which seriously enters into competition with the old established methods of pipe founding. In all branches of industry employing iron there have been three periods during which, by progressive stages, cast iron, wrought iron and steel have been used, and new systems of construction have gradually developed as improvements in the production and in the quality of material have been effected.

The old custom of employing cast iron prevails to a great extent in Great Britain; while America has for many years built pipes of wrought iron, and is only now making occasional use of steel. British progress has developed from cast iron to steel with no long period of wrought iron. The explanation is simple. America at one time had to purchase from Great Britain, and soon found that wrought-iron plates brought from England when made into water mains cost less than imported cast-iron pipes, the bulk and weight of the latter involving very heavy charges for freight. On the other hand, cast-iron pipes maintained their supremacy in Great Britain, because of the plentiful supply of metal, the simplicity of construction and the accessibility of the foundries. As each country naturally preferred the cheapest article, the habit of specifying wrought iron pipes in America and cast-iron pipes in Britain became general. The introduction of mild steel several years ago brought about a great change in the British iron trades, resulting in the erection of several large works for its production. At these works machinery was erected capable of rolling plates of larger area than had hitherto been customary at other works manufacturing wrought iron; the facilities offered by large plates of steel for general purposes rapidly secured the successful development of the new industry, and permitted the construction of steel water pipes at prices which brought them into competition with cast-iron pipes.

America being early in the field as a manufacturer of wrought-iron pipe from plates—chiefly imported from England—equipped her works with plant and machinery suitable for the sizes of plates then procurable. Britain, entering upon the plate-pipe industry at a much later date, has installations of machinery adapted to the dimensions of steel plates as now rolled. Hence it has become the practice in America for engineers to specify wrought iron pipes built from a large number of small plates, and for British engineers to employ a small number of large plates. The advantage of the latter course is obvious, as the number of seams, whether welded or riveted, is greatly reduced.

The number of seams and cost of making them had proved to be great obstacles, which hindered the adoption of wrought-iron pipes in Britain, even had prejudices against the use of wrought iron in regard to strength and durability not existed.

Hydraulic engineers were, before the days of steel, in many cases ignorant of the strength of wrought iron, and could not realize that a thin plate pipe of comparatively pure metal could be as strong and as durable as a thick pipe of cast iron—an impure metal. Therefore, with prejudice and cost against the adoption of wrought-iron pipes in Britain, the old custom of using cast iron still prevailed; but in America financial considerations overruled prejudices, and the cheaper form of pipe (wrought-iron) was adopted.

ADVANTAGES OF STEEL PIPES OVER WROUGHT-IRON.

The example shown by America in the extensive use of wrought-iron pipes induced the writer, some 10 years ago, to investigate the causes of the difference between American and British practice, and, believing that if pipes made of wrought-iron or steel could be produced in Britain at a less cost per unit of length than cast-iron pipes, the prejudice against such pipes could be overcome, careful study was given the subject, and plans matured for producing plate pipes of large diameter with less riveting than usual in American practice. As this could only be effected by the strictest economy in weight of materials and labor, it became a necessity to employ open hearth mill steel of the highest possible tensile strength.

To make this more intelligible. At a time when only plates of wrought-iron were obtainable, a pipe, say 34 ins. external diameter, ⅛-in. thick, would be built of two plates in the circumference, such plates being not more than 42 ins. wide. At the present time, if built of steel of the same thickness, there would only be one plate in the circumference, and it would be 63 ins. wide. Assuming that the laps in the seams are respectively 2½ ins. longitudinal and 1¼ ins. circumferential, and the rivets are 1⅛ ins. pitch in the double riveted longitudinal seam, and 1¼ ins. in the single riveted circumferential seam, and the riveting is the same in both wrought-iron and steel pipes—it is clear that in a length of 1,000 ft. there would be required:

	Wrought iron.	Steel.
No. of plates	588	194
Size of each plate	59 × 42 ins.	115¾ × 63 ins.
Total weight of plate	27.79 tons.	28.03 tons.
Number of rivets	57,036	32,980
Total weight of rivets	0.69 tons.	0.40 tons.

It is manifest that steel possesses decided advantages in economy of labor, as the reduction in number of plates and rivets implies proportionate reduction in caulking and punching.

DURABILITY OF STEEL PIPES.

The question of durability is one which is frequently referred to, and about which many opinions are expressed. In 1886, the writer's firm being desirous of obtaining the scientific evidence of expert analysts, obtained reports upon specimens of cast-iron, wrought-iron, and steel. These reports were published in 1887, and show that steel is less liable to corrosion than wrought or cast iron.

The best precaution against corrosion is to have the pipes galvanized, then coated with natural asphaltum; or, when the latter is not procurable, with a specially prepared composition of pitch, tar, petroleum, linseed oil, and chalk. The composition is melted in a horizontal bath, heated to a temperature of 250°. The pipes are immersed, and remain in the bath until they acquire the same temperature as the fluid composition As the pipes are lifted out, it is desirable to rotate them on the surface of the composition; the thickness of the coating can then be increased to $\frac{1}{32}$ in., or greater if desired. The smooth glassy surface thus produced quickly sets hard, and when the pipes are laid in the ground no injurious action results from contact with damp earth.

Pipes should, if possible, be coated as they are laid in the trench, even although they have been coated at the manufacturer's works. The advantage of this is apparent. All surfaces abraded in transit are re-coated and preserved.

Galvanized pipes should not be laid in the earth until they have been coated, as in many instances acids in the earth decompose the zinc, and corrosion sets in more rapidly in such cases than would be possible in pipes not galvanized.

STRENGTH OF STEEL PIPES.

With regard to tensile strength, compared with other material used for pipe manufacture, steel is undoubtedly the very best material. The ultimate tensile strength of glazed stoneware pipes never exceeds 350 lbs. per sq. in.; flint glass, 2,400 lbs.; cast iron, 18,000 lbs.; steel, 62,720 lbs. The relative strengths are therefore as follows:

Glazed stoneware	1	Cast-iron	51.4
Flint glass	6.857	Mild steel	179.2

Steel is therefore 3.48 times stronger than cast-iron.

Specifications for wrought-iron pipes usually limit the tensile strength of plates between 50,000 lbs. and 60,000 lbs. per sq. in. The practice for steel plates ranges from 56,000 to 72,000 lbs. For comparison a fair approximation is arrived at if wrought iron is taken at 50,000 lbs. and steel at 65,000 lbs. As steel is therefore on an average 1.3 times stronger than wrought iron, it is clear that for pipes of equal strength of plate, and allowing that the riveted or welded seams are also of equal strength in both, the thickness of mild steel need only be about 0.77 of the thickness of wrought iron.

Leaving factors of safety and the strength of seams out of consideration for the present, the bursting pressure of a pipe is expressed by the formula:

$$p = \frac{t \times 2s}{D}.$$

in which p = the bursting pressure, t = the thickness of the pipe, s = the strength of the metal per unit of area of cross-section, and D = the diameter. Therefore, assuming an ideal pipe 20 ins. in diameter, in which the tensile strength of the plate is uniformly maintained throughout, built of plates 0.2 in. thick, if made of wrought-iron of 23 tons, or 51,520 lbs., tensile strength, p, the bursting pressure, would be 1,030 lbs.; but if made of steel, of 30 tons, or 67,200 lbs. tensile strength, p would be 1,344 lbs., or 1.3 times greater than for wrought iron.

In like manner, if an ideal pipe of wrought iron is compared with one of equal strength of steel, the formula becomes:

$$t = \frac{p \times D}{2s}.$$

Therefore a wrought iron pipe, 20 ins. internal diameter, having a resistance to bursting of 1,000 lbs., would require to be made of plates 0.1941 ins. thick, and a steel pipe of plates 0.11488 in. thick, the thickness of the steel being 0.7667 of the wrought iron.

Allowance must be made for loss of strength in riveted seams and unequal strength of plates, and a sufficient margin of safety must be provided to meet variations in pressure, friction, wear, collapse and other causes of weakness.

The custom in America has been to work more nearly to the bursting limits than in Great Britain. Some manufacturers in America calculate the working strength of pipes on a low basis of 7,500 lbs. per sq. in. of section of plate; but in many cases the working strength is based upon wrought iron having a safe limit, after all deductions for loss of strength in riveted seams, of 12,500 lbs., and others go as high as 18,750 lbs. In other words, if wrought iron, as used in America, has a tensile strength of 50,000 lbs. per sq. in. of section, and 25% is allowed for reduction in strength at riveted seams, the factors of safety range from 5 to 2.

One of the most recent steel pipe lines of considerable importance, constructed upon American principles of design, is that for the Vancouver Water-Works, fully described by Mr. H. B. SMITH, M. Can. Soc. C. E., in his paper before the Canadian Society of Civil Engineers. In his reply to the criticisms made upon his paper, Mr. SMITH says the tensile strength of the material is 72,000 lbs., 75% of which is treated as the net strength of the riveted seam; thickness of plate, 0.11 in.; factors of safety ranging from 7.6 to 4.13, and he gives also a table showing that riveted wrought-iron pipes used at Virginia City, Nev., have factors of safety ranging from 5 to 2.40.

Taking these instances as evidence of modern Canadian and American practice, the average factors of safety are 5.865 in Canada and 3.6 in the United States. In the former case steel has a tensile strength of 72,000 lbs., and in the latter wrought iron has 55,000 lbs.; the average net strength of each material per sq. in. of section is 9,000 lbs. for steel and 10,700 lbs. for wrought iron.

The most recent British practice is to allow 60,000 lbs. for ultimate tensile strength, and to consider the resistance to internal pressure under four classes:

(*a*) High-pressure pipes, double riveted.
(*b*) Medium-pressure pipes, double riveted.
(*c*) Low-pressure pipes, double riveted.
(*d*) Low-pressure pipes, single riveted.

(*c*) and (*d*) are for pipes wherein the pressures are low, but the thickness must be increased to resist corrosion, external pressures, and to provide stability.

The following table gives the data upon which the strength of riveted pipes is based:

	No. 1.	No. 2.	No. 3.	No. 4.
Ultimate tensile strength, lbs.	60,000	60,000	60,000	60,000
Deduct for variation of thickness in rolling	2½%	2%	1½%	1%
Deduct for loss of strength in riveted seam	30%	44%	58%	72%
Total deduction	32½%	46%	59½%	73%
Factor of safety	5	5	5	5
Net strength of pipe per sectional sq. in. of plate lbs.	8,100	6,480	4,860	3,240

BOWIE, in his "Practical Treatise on Hydraulic Mining," p. 160, states that the Spring Valley Water Co. strain their pipes from 11,400 to 13,000 lbs. per sq. in.; and in table XV in the same volume it is stated that a pipe at Texas Creek is strained to 16,952 lbs., and in table XXI. reference is made to a pipe in the Cherokee line which bears a maximum strain of 17,549 lbs.

Sixteen thousand and forty pounds is the working strength of plate in one case in pipes referred to by Mr. SMITH in his table of strengths and pressures of riveted wrought-iron pipes in Virginia City, Nev., working under heads up to 950 ft. The diameter is 11½ ins.; thickness of plate, 0.148 in.; factor of safety, 2.40; ultimate strength of plate, 55,000 lbs.; reduction for loss of strength in riveted seam, 30%. In another case in the same table for pipes working under heads up to 200 ft., the diameter is 11½ ins.; thickness of plate, .065 in.; factor of safety, 5; ultimate strength of plate, 55,000 lbs.; reduction in strength of riveted seam, 30%, and the net working strength per sectional sq. in. of plate is only 7,700 lbs.

Cases have also been reported from America in which the factor of safety is only 1.5, but no authentic information can be obtained regarding the tensile strength and coefficient for weakness in riveted seams. Assuming, however, the former to be 50,000 lbs. and the latter 30%, the working strain upon plates would be as much as 23,333 lbs., which is certainly most dangerous practice.

An examination of the general principles affecting the working pressure, diameter of pipes, and thickness of plates points to a very wide diversity of opinion among manufacturers; the range in America, from 18,750 to 7,500 lbs. for wrought iron, indicates that the subject of thickness in relation to diameter and pressure is either not considered at all, or that manufacturers run great risks in a reckless manner for the sake of commercial advantage. The extremes above quoted, if applied to the case of a pipe 20 ins. diameter, working under a pressure of 200 lbs. per sq. in., indicate that the speculative maker would build his pipe of plates .107 in. thick, and the cautious builder of plates .258 in. thick. The tendency in America appears to be to use lower factors of safety than are customary in Great Britain, and the absence of a recognized standard on which to base specifications permits of too great freedom and gives latitude to speculative traders to undermine the principle of fair trade competition. There is no reason why manufacturers should not agree upon a standard scale of measure applicable to riveted steel and wrought-iron pipes. To arrive

* A paper by D. J. RUSSELL DUNCAN, Assoc. M. Inst. C. E., M. Inst. M. E., Managing Director of the Steel Pipe Co., Ltd., Kirkaldy, Scotland, read at the eleventh annual convention of the American Water-Works Association.

at consistency and uniformity a mean might be established, which would at the same time be in accord with American practice in regard to low factors of safety and yet conform to British ideas in dealing with steel. To secure this object the writer proposes the adoption of the four classes of riveting previously referred to, and that all calculation should be based upon an ultimate strength of material of 60,000 lbs. This is higher than the average ultimate tensile strength of American wrought iron and considerably lower than that of the best qualities of British steel; but as a uniform factor of safety of 5 is proposed, the net strength is nearly equivalent to the general average in American specifications and well within the limits of safety recogn zed in Britain. An allowance is provided to cover usual variations in thickness of rolled plates, calculations being based upon the minimum thickness of plates after deducton of steel manufacturers' margin.

From the very wide range indicated, it is clear that no satisfactory rule for calculating strength of wrought-iron or steel pipe is in practice; and, as purchasers of pipes cannot always be expected to investigate the principles which govern manufacturers in recommending thicknesses and systems of riveting, it seems to the writer that a discussion on this important matter would not only be of advantage to the public, but also to the manufacturers, and he therefore recommends to the American Water-Works Association that the following resolution be submitted for adoption:

"That this Association, with a view to insure public safety, economy in construction, uniformity in design, and consistency in the application of wrought-iron and mild-steel riveted pipes for conveying steam, and water and gas, do hereby adopt and recommend for universal adoption the standards for strength and pressure, resulting from the formulas:

$$t = \frac{p \times d}{16200} \qquad p = \frac{t \times 16200}{d} \qquad d = \frac{t \times 16200}{p}$$

t = thickness of plate in inches.
p = safe-working pressure in pounds per square inch.
d = internal diameter of pipe in inches.

16,200 is the coefficient for double-riveted pipe system (*a*).
12,900 " " " " (*b*).
9,720 " " " " (*c*).
6,480 " single-riveted " (*d*)."

Questions regarding resistance to collapse from external pressure sometimes arise. It therefore becomes important when laying down plans for water supply to know the depths at which the pipes will be laid otherwise large pipes, whether earthenware, cast iron or steel, are liable, the two former to fracture, the latter to collapse by bending, wherever the depths of the pipes under road level is insufficient to prevent the weight of heavy wagons bearing upon them.

Whenever external pressure has to be considered, the best forms of steel pipes are short cylinders of welded pipes riveted together with butt joints and external cover strips, such strips occurring at intervals of 4 to 6 ft. apart. The frequency of these circular cover strips adds considerably to the strength of the pipes, as the strips act as stiffening beams in resisting external pressure. Pipes laid at a depth of four diameters are not affected by surface loads, and the question of collapse need not in such cases be considered. This fact should be borne in mind.

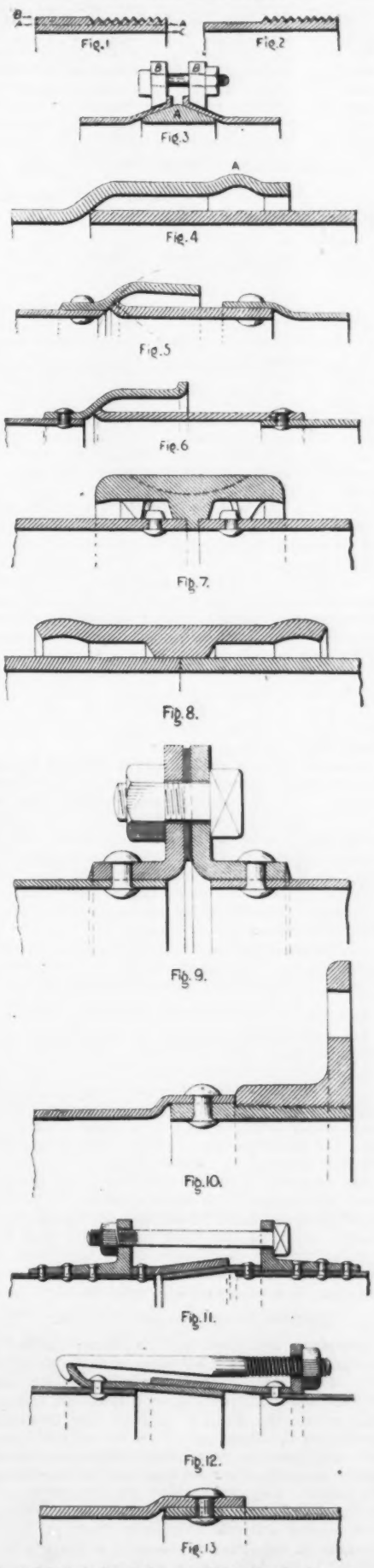
Generally it may be taken as certain that wherever a cast-iron pipe 1-in. thick is safe, a steel pipe ¼-in. thick is safer. In the one case the cast-iron will break and leak if undue loads are imposed, but in the other only flattening or bending without leakage occurs.

Calculations for resistance to collapse are entirely different from those for resistance to internal pressures. No reliable formulas have yet been introduced for such calculations. The nearest approximation for general purposes is: Resistance to internal pressure = 1.0; resistance to external pressure = 0.4.

DIFFERENT STYLES OF PIPE JOINTS.

The methods of coupling pipes together are very numerous; the common form of screwed joints used for small tubes is not applicable in large diameters, because of the expense, and is objectionable because of the waste of material. The strength of a pipe to resist internal pressure must always be calculated at the thinnest and weakest part. If a pipe is screwed, as shown in Fig. 1, the metal is thinnest at the bottom of the thread, and the limiting thickness of pipe for working pressure required must be at that point on the dotted line *A*. The extra metal between the lines *A* and *B* throughout the whole line of pipes is of no use, and adds weight and expense to the pipe. The thickness *A C* must be sufficient to stand the pressure, and the only means of economising the material and yet maintaining the full strength of the pipe is by swelling the end of the pipe (Fig. 2), but this adds greatly to the expense, and cannot therefore be recommended for pipes over 6 ins. diameter.

The joint shown in Fig. 3 [described in ENGINEERING NEWS, Feb. 14, 1891] is used for small tubes, but is not recommended for large diameters. The tubes are expanded at the ends, after having loose flanges, *B B*, fitted over them, and are drawn together by bolts and nuts over a turned core, *A*. This joint is very cheap, and has the advantage that the joints may be quickly made; also that the tubes may be very thin, but it has the disadvantage of projecting loose flanges, which are not convenient for shipment.



PIPE JOINTS FOR RIVETED STEEL PIPES.

The Schulz joint (Fig. 4) is a very good one for welded pipes. It is expanded on the ends of such pipes; but it has the disadvantage that the thickness of the metal is reduced at *A*, the point of largest diameter, and therefore the point where greatest strength is required.

The Duncan joint (Fig. 5) is better than the last, because the socket can be rolled of steel of greater thickness than the pipe, thereby giving greater strength where wanted. The socket is shrunk upon or riveted to the pipe, and in some cases the pipes are expanded into the socket in the same manner and by the same process as the expansion of boiler tubes into tube plates. A feature of this joint is the bearing surface of the spigot on the bottom of the socket. It is so designed that the surface of contact is spherical and allows the angular deviation, horizontal or vertical, up to the limiting point at which the spigot end of the pipe touches the extreme end or mouth of the socket. The circle represents a sphere, and it will be seen that the bearing of the spigot upon the socket is upon its surface.

The best joint on the socket and spigot principle is a development of the two former, and is known as Riley's stamped steel socket joint (Fig. 6). The great advantage of this joint is the stiffness obtained at the mouth of the socket by the rim, which is favorable for caulking with lead. Stamped sockets are also truly cylindrical, and being without welded seams, greater strength is obtained.

The Converse lock joint (Fig. 7) is an excellent form, made of a cast-iron collar with lead space at both ends, the collar having recesses into which projecting rivet-heads fixed on the ends of the pipes are inserted, and locked by moving the pipe through a small part of its circumference.

The form of joint known as the Kimberley joint (Fig. 8) is similar to the Converse patent joint, excepting that the pipes are not locked into the joint.

The flanged joint is shown in Figs. 9 and 10. The flanges are preferably stamped in dies, in which case they are truly cylindrical, and do not require to be faced; but they are sometimes made from angle iron welded into rings.

Numerous other forms of joints are necessary, according to circumstances. When drainage pipes of large diameter are required, the simplest joint is a tight-fitting socket and spigot joint, drawn together by lugs and bolts (Figs. 11 and 12). The joint shown in Fig. 11 was first used for the storm outfall, 36 ins. diameter, at Bournemouth. The pipes were laid under seawater and jointed by divers.

As steel pipes are usually supplied in long lengths (welded pipes 14 ft. to 18 ft., and riveted pipes 18 ft. to 40 ft.), it is necessary to provide means for allowing angular deviation in the line of pipes without creating strains in the joints. This is effected by making the ends bear upon each other at an angle of 45°, as shown in Fig. 5.

The Converse lock joint does not allow of much angular deviation, but the other forms referred to (excepting the flange joint) will nearly all allow considerable divergence from the true line, whether horizontal or vertical.

Special attention should be given to beveling the spigot ends, because it saves a very great deal of time in laying pipes, and there is no risk of fracture or leakage; whereas when laying cast-iron pipes the greatest possible care must be taken to fit the pipes together in perfectly true lines, otherwise the strains set up in the joints by the leverage, due to the length of one or more pipes hanging upon the joint, frequently causes fracture at the joint.

The simplicity of all the joints referred to is an important matter in their favor. They can all be made by men ordinarily accustomed to laying cast-iron pipes, and are more easily handled, no complication of any kind, either regarding yarn packing, lead packing, leveling, caulking or finishing, ever being met with.

The saving in cost of lead, laying, time and labor by using these joints as compared with joints of cast-iron pipes must be noted. If riveted steel pipes are used in 24-ft. lengths instead of cast-iron pipes in 12-ft. lengths, it is obvious that there are only half the number of joints to make, but each joint uses only about 75% of the lead required for a cast-iron pipe joint. The mean diameter of the annular space for lead is smaller than in cast-iron pipes, because the thickness of steel in the pipe is less than the thickness of metal in the cast-iron pipes.

Tightness of the joints is increased by the use of steel sockets, because the lead can be caulked more firmly than in a cast socket, as there is no danger of splitting. The risk of leakage is also reduced in consequence of the reduced number of joints.

The superiority of the coating used for steel pipes—its smooth and glassy surface—increases the discharge of water through *welded* as compared with cast-iron pipes, because the friction is very greatly reduced; but no advantage can be claimed for increased discharge through pipes which are riveted together with rivets whose heads project inside the pipe. The projecting heads obstruct the flow, even though carefully coated, and the advantage of smooth bore can only be claimed for welded pipes.

The method of riveting the circumferential seams together is illustrated in Fig. 13. This system not only maintains uniformity in the internal diameter of the pipe, but greater accuracy in riveting. The plates are punched on multiple punching machines, bent into cylinders, and the ends required to overlap are expanded by suitable machinery.

The Equipment of Freight Cars with Master Car Builders' Automatic Couplers.

(WITH MAPS NO. 33 AND 34.)

As promised in our issue of March 28, we publish herewith complete returns from the railways of the country which have begun the use of automatic freight car couplers of the Master Car Builders' type. The total extent of the roads included in the table is 94,065 miles, or 56½% of the total railway mileage of the United States; and their total freight equipment is 806,629 cars, or 70% of the estimated total of the United States.

On Jan. 1, 1891, the total number of cars equipped with M. C. B. automatic couplers was 102,347, an increase of 53,542 over the number of cars equipped about the beginning of 1890. More important, however, than all else in the table is the column giving the answers to the question: "Are you putting M. C. B. standard couplers on *all* new freight cars?" Companies controlling 53,583 miles of railway and 567,433 cars replied "Yes" to this question; and they are shown in our map No. 34 in full lines.

Our second question was: "Are you putting M. C. B. standard couplers on *some* new cars; if so, on how many, and what classes?" In answer to this question, companies controlling 18,228 miles of railway and 135,010 cars reported that they were equipping new cars of some special classes with the coupler. All these roads so reporting are shown on our map No. 34 by *dotted lines*. As may be seen by referring to the table, roads of this second class are applying the coupler to all new box and stock cars; and among this class are some of the roads which have made greatest progress in equipping their cars with the M. C. B. coupler.

The total mileage included in these two classes and shown on our map No. 34 is 71,811 miles, about 43% of the total mileage of the United States; and the total number of cars in the freight equipment of these companies is 702,443, or about 60% of the total freight rolling stock of the United States, estimating the latter at 1,165,000 cars. It is plain enough that in considering the progress of this reform the number of cars, controlled by the companies which are committed to it, is a much more correct index than is the number of miles operated. For example, the fact that the Delaware, Lackawanna & Western is equipping all new cars with M. C. B. couplers, as shown by the table, is far more important than would be similar action by the Fremont, Elkhorn & Missouri Valley, which, with a half more mileage has not a tenth as many cars, the exact figures being as follows:

Company.	Mileage.	Cars in freight equipment.
Delaware, Lackawanna & Western	893	35,837
Fremont, Elkhorn & Missouri Valley	1,264	2,857

Hence it must be borne in mind that the progress of the reform is even greater than our map indicates. The roads shown upon the map include most of the wealthy, progressive and influential railways in the United States, those which own the bulk of the rolling stock, which keep their cars in most active service, and which carry the bulk of the traffic. In general the roads which are active in this reform are the trunk line systems, the Chicago systems, the most important of the transcontinental lines, and nearly all the important railways of the South. The railways which are conspicuous by their absence from the map are the roads of the Southwest, of Canada and of New England.

With the exception of the New England roads, however, there is no real opposition to the reform, so far as we can learn. The delay proceeds in many cases, doubtless, from the old habit of considering the automatic car coupler question an unsolvable one—a habit for which there was much excuse a half dozen years ago, but no excuse now. As for the New England roads, whose persistent opposition to the M. C. B. coupler would be admirable if it were exerted in a better cause, our map shows, plainer than words or figures can do, what an insignificant part of the railway system of the country the New England roads constitute.

THE PROGRESS MADE IN A YEAR.

In our issue of December 21, 1889, statistics were published showing the progress in the introduction of automatic couplers made up to that time. The showing then made was sufficient to convince any unprejudiced investigator that the M. C. B. automatic coupler was to be the coupler of the future. If any doubt on that point were possible, however, it must be effectually set at rest by our showing in this issue on our double map of the progress which was made in 1890. In every particular the progress made in that year exceeded all that had been done in the years previous. The following table clearly shows this:

	Dec., 1889.	Dec., 1890.	Increase.
Mileage of railways applying M. C. B. couplers to new freight cars.....	35,855	71,811	35,926
No. of cars equipped with M.C.B.couplers	48,805	102,347	53,542

The real progress is even greater than these figures indicate, for among the roads which in 1890 adopted the policy of equipping new cars with M. C. B. couplers are some of the largest and most influential railways of the country, controlling the greatest number of cars. Again the mileage figures for 1889 in the above table include the Atchison, Topeka & Santa Fé system 7,122 miles in extent, which at that time reported to us that all new cars were equipped with the coupler. This year the company reports that that policy is not now in force, and the system is therefore omitted from the above table and from our map No. 34. This is the only case we have found where a company has abandoned the policy of equipping all new cars with M. C. B. couplers after giving it a trial. The change of policy in this case was due doubtless to the financial condition of the company combined with an unfortunate choice of a type of coupler which proved weak in service. Since then it has been materially improved.

If the Atchison mileage were excluded from the above total, therefore, the mileage figures in the first line would be: for 1889, 28,763 miles; for 1890, 71,811, showing a total increase for the year 1890 of 43,048 miles.

It is to be further noted that the railways reporting the equipment of *all* new freight cars, or those shown by full lines upon our map, amounted at the close of 1889 to 19,465 miles; while at the close of 1890 companies controlling no less than 53,583 miles of railway reported that *all* new cars were being equipped with M. C. B. couplers. If we exclude the Atchison mileage from the 1889 total, the comparison is: At close of 1889, only 12,343 miles. At the close of 1890, 53,583 miles.

Taking all these things into consideration, an idea may be gained of the immense progress which was made in the automatic coupler reform during 1890.

PROGRESS IN THE NUMBER OF CARS EQUIPPED.

Far more importance is to be attached to the statements shown in our table of the policy which the railway companies have adopted than to the number of cars equipped. There is room for error in reporting the number of cars equipped, and we have very trustworthy evidence that the number of cars equipped is in many cases greater than the number officially reported to us and shown in the table. There were probably at least three or four thousand more cars equipped with automatic couplers on Jan. 1, 1891, than are shown by our table. But in answering the direct question, "Are you putting M. C. B. standard couplers on *all* new freight cars?" there is little chance of mistake, and we place much confidence in the accuracy of these answers.

EQUIPMENT OF CARS SENT TO SHOP.

In reply to the question, "Are you putting M. C. B. standard couplers on *all* cars sent to the shop for general repairs?", companies controlling 19,595 miles of road and 197,162 cars report that all cars sent to shop receive the M. C. B. coupler. The Chicago, Burlington & Quincy puts it on all cars requiring new draft timbers. Some other roads seem to have a rule to equip a certain number of shopped cars per month. The roads which put the coupler on only part of the cars sent to shop for general repairs give varying answers concerning their practice. The general idea, however, seems to be to apply the coupler to the best classes of recently built cars which are doing heavy service, or else to certain classes of cars to which the coupler is at present confined. The total extent of the roads reporting that *some* cars sent to shop receive the coupler is 22,432 miles, and the number of cars which they control is 258,730.

Thus in tabular form we have the following very good showing:

	Mileage operated.	Frt. cars controlled.
Companies applying M. C. B. couplers to *all* cars sent to shop for general repairs.....	19,595	197,162
Companies applying M. C. B. couplers to *some* cars sent to shop.....	22,432	258,730
Total.....	42,027	455,892

Our statistics published Dec. 21, 1889, showed only 11,983 miles of railway reporting the application of the coupler to all cars sent to shop for general repairs, The growth in favor of the coupler during the past year, therefore was no less gratifying in this than in other particulars.

AUTOMATIC CAR COUPLERS IN THE PAST.

It may be of interest at this time to review briefly the course of events which led to the selection and adoption by the Master Car Builders' Association of what is now certain to become the standard car coupler of America. The need of an automatic coupler for freight cars has been generally recognized for probably two-score years, and thousands of inventors have labored to produce a device which would fill all requirements. For many years railway men paid little attention to these inventions, considering the problem impossible of solution. After a time, however, the enormous roll of accidents and injuries received in coupling cars with the link and pin became too serious a matter to be neglected. Public opinion, expressed in some of the states by legislation, demanded that a fair trial, at least, should be given to the new inventions. Some of the more promising devices came under the control of influential men, and a number of progressive roads in different parts of the country began experimenting with the various types of automatic coupler. Some of these were found to do excellent service, and a number of cars were equipped with them. There was, however, one insurmountable objection, which prevented the extensive use of any automatic coupler, no matter how perfectly it filled all mechanical requirements. No railway could know what the other railways of the country would do in the matter, and unless all the railways of the country agreed to apply a single coupler or type of coupler, the independent adoption of an automatic coupler by any road promised to do more harm than good.

The case was an urgent one. Accidents among trainmen due to coupling cars had reached several thousand per annum in the United States. Laws had been passed requiring the railways to adopt automatic couplers. With no mutual organization possessing any authority among the railways of the country, how should the vital question of what automatic coupler to select for general adoption be decided?

In 1882 the Master Car Builders' Association was reorganized on a new basis, and representative members were given votes in proportion to the number of cars under their control, a change which greatly increased the Association's influence and importance. At the meeting, at which this change was made, a brief committee report was presented stating that the use of an automatic coupler was desirable, and recommending that the subject be referred to the executive committee. No progress toward uniformity was made, however, until 1884, when, after a long discussion, the convention voted unanimously "that the best coupler mechanically is one which performs the coupling along a vertical plane."

At the same time a movement was made for an expert test of various types of automatic couplers; but it was not until the convention of 1885 that decisive action in the matter was taken. In Sept. 15, 1885, 42 couplers were tested at Buffalo, N. Y., by the Executive Committee of the Association; and as a result of this test 12 couplers were selected, and arrangements were made for the application of each to 10 cars for trial in actual service.

The information gained by the service tests, and by the Burlington brake tests of 1887 (which conclusively demonstrated that the loose slack of the link-and-pin type of coupler was not a necessity in starting a train), led the Executive Committee of the Master Car Builders' Association at the Convention in 1887 to recommend the adoption of the Janney type of automatic coupler as the standard of the Association. On submission to letter ballot it was adopted by a vote of 474 to 194, Oct. 13, 1887.

ONE YEAR'S PROGRESS IN THE EQUIPMENT OF FREIGHT CARS WITH M. C. B. AUTOMATIC COUPLERS.

(COMPILED FROM OFFICIAL REPORTS TO ENGINEERING NEWS.)

Railway.	Mileage operated.	Number of cars in freight equipment.	Are you putting M. C. B. standard couplers on *all* new freight cars?	Are you putting M. C. B. standard couplers on *all cars sent to shop for general repairs*?	Total number of freight cars equipped with M. C. B. couplers: On Jan. 1, 1891.	In Dec., 1889.	Increase in 1890.	Per c'ntage of total freight equipment having M C.B. couplers, Jan. 1, 1891.	Remarks.
Allegheny Valley	259	2,859	Yes.	All.	601	350	251	21	
Atchison, Top. & S. Fe	7,122	25,515	No.		1,000	700	300	4	
Atlantic Coast Line*	277	1,259			1,018	658	360	81	* See also Wilmington & Weldon.
Baltimore & Ohio	1,950	27,751	Box and refrigerator	No.	1,325	375	950	5	
Beech Creek	160	1,908	Yes.	All	600			32	
Buffalo, Roch. & Pitts.	289	5,521	Yes.		500	None.	500	9	
Burl. & Mo. R.	3,027	7,246	All box and stock	34-ft. 40,000-lb. box and stock.	749	100	649	17	
Burl., Cedar Rap. & No'n	1,653	4,206	Yes.	All.	299	None.	299	7	
Cape Fear & Yadkin Valley	338	559	Yes.	All requiring new couplers.	293	160	133	53	
Central R. R. of Ga.	1,746	5,632			2,400	2,400			
Central R. R. of N. J.	636	34,309	Yes.	All.	602	None.	602	2	
Chesapeake & Ohio	910	11,370	Yes.	*20 cars per month.	1,300	110	1,180	11	* On 10 hopper-bottom and 10 box, 300 equipped since Jan. 1.
Chicago & Alton	849	7,655	No (see Remarks)		125	None.	125	2	" No new cars should be built without air brake and Janney coupler.'
Chicago & No'w'n.	4,258	24,467	Yes.	All modern built cars.	2,673	1,310	1,363	11	
Chic., Burl. & Quincy.	2,780	20,863	Yes.	All req'ring new draft timbers.	2,513	845	1,668	12	
Chic., Milwaukee & St. Paul	5,703	28,613	Yes.	All.	1,987	None.	1,987	7	225 cars equipped in first two months of '91.
Chicago, Peoria & St. Louis	410	1 232	Yes.	Not yet.	250	None.	250	20	
Chicago, Rock Island & Pac	3 000	14, 98	Yes.	All.*	3,032	2,200	832	21	* Also on 34 ft. cars requiring new draft timbers.
Chic., St. Paul, Minn. & O.	1,400	7,772	Yes.	All lately built box.	200	None.	200	3	
Choctaw Coal & Ry. Co.*	65	934	Yes.	All.	844	700	744	93	* All cars are equipped.
Cleve., Akron & Columbus	194	2,468	Yes.		500	None.	500	20	
Cleve., Cin., Chic. & St. L	2,023	18,911	Yes.	Box and stock 34 ft. or longer.	4,700	1,800	2 900	25	
Cornwall & Lebanon	22	50			3	None.	3	6	
Cumberland Valley	148	600	Yes.	None.	*None.	None.			* 85 cars now building will have M. C. B. couplers.
Del. & Hud. Canal Co., No'n Dept.	532	12,650	Yes.	All.	*687	None.	687	5	* 1,158 new cars under contract will be equipped.
Del., Lack. & W'n.	893	35,837	Yes.	No.	861			2	
E. Tennessee, Va. & Ga.	1,780	10,323	Yes.	No.	1,500	1,500	None	15	
Fall Brook Coal Co.	243	3,706	Yes.	Gondola and stock cars.	563	None.	563	15	
Fitchburg	369	6.321	No.	No.	125	None.	125	2	
Flint & Pere Marquette	625	3.573	Yes.	All.	589	None.	589	17	
Fremont, Elkhorn & Mo. Valley.	1,264	2,857			10	None.	10		* Presume we will.
Georgia R. R.	379	1,152	Yes.	None	100	100		9	
Georgia Southern & Fla.	385	2,304	Yes.	All.	1,021	500	520	44	
Grand Rapids & Indiana	572	3,052	Yes.	25 to 50 per month	500	225	275	16	
Hannibal & St. Joseph	296	1,553	34-ft. box and stock	34-ft. box and stock	183	None.	183	12	
Housatonic	110	1,203	No.	No.	200			15	
Houston & Texas Central	703	2,544	Yes.	No.	56	None.	56	2	
Intercolonial	1,144	6,728	No.	No.	35	None.	35	1/6	Have six different kinds on trial.
K. City, Fort Scott & Memphis	1,192	8,403	No.		*158	None.	158	2	A trial order, on cars of all classes.
Kentucky Central	253	987			100	None.	100	10	
Lake Shore & Mich. So'n.	1,410	19,187	Box and stock	On 211 box cars.	2,287	1,700	587	12	
Lehigh Valley	804	47,992	Yes.	On some cars.	3,550	1,350	2,200	7	
Louisville Southern	124	500	Yes.	No.	500			100	
Mich. Central	1,537	13,345	Yes.	34-ft. cars.	1,492	165	1,327	11	
Milwaukee & Northern.	376	1,678			350	None.	350	26	
Millwaukee, L. S. & Western	692	4,736	* Yes.	No.	118	10	108	3	* Putting it on 460 cars now building.
Minneap, St. P. & Sault S. M.	795	3,186	Ore cars	No.	124	None.	124	4	
Monterey & Mex. Gulf	310	381			290	None.	290	76	
N. Y. Central & Hudson R.	1,421	40,000	Yes.	All.	*10,000	8,400	1,600	25	* Official estimate.
N. Y., Chic. & St. Louis	524	6,941	Yes.	All	575	160	415	8	
N. Y., L. Erie & Western	2,089	38,012	Yes.	Butter and cheese cars.	6,600	3,878	2,722	17	
N. Y., Ont. & Western.	424	3,838	Yes.	All.	1,575	50	1 525	41	
N. Y., Phila. & Norfolk	112	600	Box cars.	Box cars	300	90	210	50	
N. Y., Susquehanna & Western.	155	2,617	Yes.	*Coal and gondola.	706	None.	706	27	*About 20 per month.
Northern Pacific	4,100	17,133	Yes.		2,100	None.	2,100	12	
Oregon & Washington	167				60	None.	60		
Oregonian—East Side	80	250	* Yes.	All new cars.	250	None.	250	100	* All new cars on broad-gage division.
Pennsylvania System:									
Lines E. of Pittsburgh & Erie	2,750	61,243	Yes.	All with std. draft rigging.	7,032	3,394	3,638	11	Since Jan. 1, 1891, couplers for over 3,300 cars have been ordered by the Pennsylvania lines.
Northwest System	997	33,210	Box, stock and refrigerator.	No.	4,507	4,284	223	14	
Southwest System.	1,646	12,787	Box and stock.	No.	1,452	1,250	202	11	
Penna., Pough. & Boston	95	705			675	250	425	85	
Phila. & Reading	1,057	33,194	* Yes.	Not at present.	4,000	None.	4,000	12	*Putting it on 5,250 cars now building.
Phila., Wilm. & Balt.	519	2,386				660			
Queen & Crescent	1,158	9,000	Yes.	Yes	50	None.	50	1	
Raleigh & Gaston	210	741	Yes.	No.	250	50	200	34	
Richmond & Danville	3,020	11,772	Yes.	Not yet.	4,151	3,857	294	35	
Richmond, Fred. & Potomac	82	125	Yes.	No.	32			25	
Rio Grande Western	432	1,062	Some cars.	No.	353	100	253	33	Putting it on 75 fruit and 25 box cars.
Rome, Watertown & Ogdensburg.	655	2,449	Yes.	No.	350	350		14	
Seaboard & Roanoke	348	900	Yes.	*All.	161	80	81	18	*Except old cars used for local work
So. Carolina	375	1,466	No.	No.	250	None.	250	17	
So. Pac. Co., Pac. System	4,278	15,207	None.	No.	*10	None.	10		* A trial lot. Rumored that general equipment is to begin soon.
Union Pacific	7,995	20,490	Fruit, stock and refrigerator.	No.	*900	None.	900	3	*Also 282 equipped with Miller couplers.
Wabash	1,950	13,833	No.	No.	90	60	30		
Wilmington & Weldon	653	1,900	Yes.	All.	722	542	180	38	
Western N. Y. & Pa.	632	8,617	Yes.	All.	1,719			20	
Wisconsin Central	800	6,205	Yes.	No.	1,300	None.	1,300	21	
Zanesville & O. River	74	650		Expect to this year.	200	None.	200	30	
Private Companies' Cars					6,370	3,061	3,309		
Estimated for companies showing total equipped on Jan. 1, 1891, but not the No. equipped in 1890.						1,631	1,631		
Totals	91,665	806,629			102,347	48,805	53,542	12.5	

It is one thing, however, for the M. C. B. Association to adopt a standard, and quite another thing to get it into general use. Notwithstanding the action of the Association, therefore, railway companies were slow at first to take action on the equipment of cars with the new standard. No statistics of the number of cars equipped with the M. C. B. couplers are in existence prior to those published in ENGINEERING NEWS of Dec. 21, 1889. From the best data available, however, we have estimated the number of cars equipped in each year since the adoption of the Janney type as standard as follows:

Before and during 1887.	During 1888.	During 1889.	During 1890.
3,000	2,500	34,000	53,500

FUTURE PROGRESS OF THE REFORM.

In our editorial columns we have discussed the weighty reasons why the equipment of the existing rolling stock should be hastened by every means possible, now that there is no further doubt that the type adopted by the Master Car Builders' Association is to be the standard in fact as well as in name.

Our statistics show the progress only to Jan. 1, 1891. Since that date we have official information of the receipt of orders by two firms of coupler manufacturers for equipping over 21,000 cars. Making no allowance whatever for what a half-dozen other active manufacturers are doing, it is plain that, unless unforeseen circumstances interfere, 1891 is to see a large increase in the num-

ber of cars equipped over 1800. Doubtless this will be accompanied by a general wheel into line of many of the prominent companies which have hitherto delayed action on this reform. Probably, too, as we have elsewhere more fully explained, legislation by Congress can be expected at an early date making the application of automatic couplers compulsory on cars used in interstate traffic. Whether this occurs or not, a constant and rapid increase in the rate of progress of the reform is practically certain. The accident statistics collected by the Interstate Commerce Commission, which showed in the year ending June 30, 1889, 300 killed and 5,757 injured in coupling cars with the link and pin, are an eloquent argument for the reform, and one which State legislatures are certain to heed if Congress does not. It is to be noted that the removal of all doubt as to what type of automatic coupler is to be the coupler of the future has thrown down the hitherto insurmountable barrier to State legislation on this subject.

We prefer to believe also that the necessary acceleration in the equipment of cars, which must take place in order to complete the reform within any reasonable time, will be had even without legislation. The leading railways of the country have shown a commendably progressive spirit in dealing with the question, and deserve credit therefor. As for the roads operated by stock-exchange speculators, and the few non-progressive roads which adopt improved methods a decade after their neighbors, they must eventually follow the lead of the rest of the country whether they want to or not.

An early and complete success may therefore be prophesied for the reform; and the progressive members of the Master Car Builders' Association who have labored so diligently to bring the movement to the point where success was possible deserve especial congratulations for the service they have rendered in the cause of humanity.

Eight-Wheel Locomotive: Southern Pacific Ry.

In our issue of March 28 we published a table of comparative dimensions of English and American locomotives of the eight-wheel type, giving dimensions and an outline diagram of a Southern Pacific engine. We have since received from Mr. H. J. SMALL, Superintendent of Motive Power and Machinery of the Southern Pacific Co., particulars of an eight-wheel engine, with cylinders of the unusual proportions of 18 × 28 ins. These engines were brought out in 1889. The accompanying diagram shows the general arrangement, but Mr. SMALL states that he has enlarged the dome from 20 ins. to 28 × 30 ins. The detailed dimensions are as follows:

Cylinders, 18 × 28 ins. Ports, 16 ins. long; steam ports, 1½ ins. wide; exhaust ports, 3½ ins. wide. Dist. c. to c. of cylinders, 6 ft. 3 ins.; center line of cylinder to valve face, 15 ins. Slide valves, 1⅛ ins. lap; 4⅛ ins. maximum travel; $\frac{1}{10}$ in. lead. Piston rod, 3 ins. diameter. Cylinder area per sq. in. of flue opening, 0.912 sq. in.

Driving wheels, 5 ft. 8 ins. diameter on tread, 3-in. tires. Truck wheels, 2 ft. 9 ins. diameter. Wheel base: driving, 9 ft.; truck, 6 ft. 3 ins.; total, 24 ft. 7 ins. Distance center of truck pin to center of driving axle, 12 ft. 5½ ins. The firebox shell is 8 ins. and 7 ins. from the centers of the driving and trailing axles, respectively, being bent in to clear the latter, as shown.

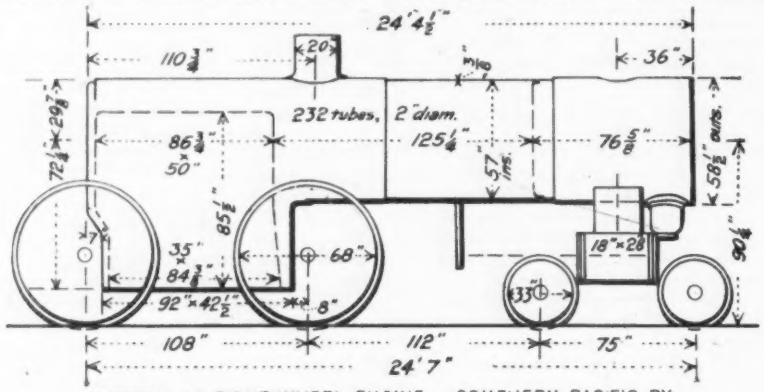


DIAGRAM OF EIGHT-WHEEL ENGINE; SOUTHERN PACIFIC RY.

The boiler is of the straight top type, built of ⅜-in. plates. The length of barrel from throat sheet to end of extension smoke box is 16 ft. 1⅛ ins. The extension front is 6 ft. 4⅝ ins. long from front tube sheet and 4 ft. 10½ ins. diameter. Diameter of barrel outside of smallest ring, 57¾ ins. Height from rail to center line, 7 ft. 6¼ ins. The firebox shell is 7 ft. 8 ins. long and 3 ft. 6½ ins. wide outside, at bottom; depth below center line of boiler to bottom of mud ring, 6 ft. 0¼ in. The tube plates are ½-in. thick; throat, side, top and back plates, ⅜-in. The firebox is 7 ft. 0⅝ in. long and 2 ft. 11 ins. wide inside at bottom; depth from inside of crown to bottom of mud ring, 7 ft. 1½ ins. There are 232 tubes, 2 ins. diameter and 10 ft. 4½ ins. long.

Working presure, 140 lbs. Grate area, 20.5 sq. ft. Heating surface: tubes (outside), 1,257.7 sq. ft; firebox, 164.2; total, 1,421.9 sq. ft. Heating surface per sq. ft. of grate, 69.36 sq. ft.; per sq. in. of cylinder area, 2.79 sq. ft.

Weight in working order: 62,000 lbs. on the driving wheels; 36,000 lbs. on the truck,; 98,000 lbs. total. Percentage of weight on driving wheels, 66.26%. Weight empty, about 87,400 lbs.

The tender is of the ordinary type, carried on 2 four-wheel trucks, with 33-in. wheels. The distance c. to c. of truck pins is 10 ft. 8 ins., the old Central Pacific standard. Wheel base, 14 ft. 2¾ ins. Total wheel base of engine and tender, 46 ft. 0⅝ in. Capacity of tank, 3,051 galls.; coal space, 12,773 lbs. Weight loaded, 69,000 lbs., with 35,050 lbs. on the leading and 34,450 lbs. on the trailing truck. Weight empty, 31,300 lbs., with 15,770 lbs. on the leading and 15,530 lbs. on the trailing truck.

THE COMPARATIVE PRODUCTION OF THE PRINCIPAL ARTICLES OF IRON AND STEEL for the three years ending Dec. 31, 1890, is the subject of a recent bulletin published by the American Iron and Steel Association. Most of this matter has already been published in our columns, but the present form is so convenient that it will bear repetition. The figures are as follows:

Net tons of 2,000 lbs. (except nails).	1888.	1889.	1890.
Pig iron, including spiegel	7,268,507	8,516,079	10,307,028
Spiegeleisen	54,769	85,823	149,162
Bessemer steel ingots	2,812,500	3,281,829	4,131,535
Bessemer steel rails	1,552,631	1,691,264	2,091,978
Open-hearth steel ingots	352,036	419,488	574,829
Open-hearth steel rails	5,261	3,340	4,018
Crucible steel ingots	78,713	84,969	79,716
Rolled iron, except rails	2,397,402	2,576,127	2,804,829
Rolled steel, except rails	1,201,885	1,584,364	1,829,247
Iron rails	14,252	10,258	15,548
Pig, scrap and ore blooms	39,875	36,260	30,783
Kegs of iron cut nails	2,170,107	1,778,082	1,806,130
Kegs of steel cut nails	4,323,484	4,032,676	3,834,816
Kegs of wire nails	1,500,000	2,435,000	3,135,911
Iron and steel wire rods	313,341	407,513	511,951

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Chicago & West Michigan.—The contract for the construction of the extension from Traverse City to Charlevoix, Mich., will probably be let before May 1. Two routes for the extension are under consideration. One follows the lake shore closely, passing through the towns of Yuba, Elk Rapids and Norwood; and the other runs directly east from Traverse City to Williamsburg and thence north via Bellaire to Charlevoix. From Charlevoix to Petoskey the partly graded roadbed of the Detroit, Charlevoix & Escanaba R. R has been purchased. The towns along the shore route offer a bonus of $1,000 per mile, and free right of way, and lands for stations. The interior route is through a fine timber country. In case the latter is selected, three branches will probably be built. One is projected to run from Mitchell to East Jordon, another from Williamsburg to Elk Rapids, and the third from Barnard to Ironton.

Pennsylvania.—It is reported that the contracts for the extension from Kaylor's Station, on the Ebensburg & Cresson R. R., to near Carrolltown, Pa., have been let to Drake, Stratton & Co., 71 Broadway, New York City. The grading is to be completed by Oct. 1.

Flint & Pere Marquette.—It is stated that work will soon begin on an independent line to Detroit. The tracks of the Michigan Central R R. are now used. The line as surveyed will run from Delray, in Springwelles, to Redford Station, on the Detroit, Lansing & Northern R. R., a distance of 13 miles.

Utica & Unadilla Valley.—At a meeting of the directors recently held the following officers were elected: President, Geo. H. Scott; Vice-President, Ralph Brandreth; Treasurer, Frederick F. Culver; Secretary, R. Floyd Clark. It was decided to issue $250,000 of bonds and construct the line from Bridgewater to New Berlin, N. Y., 20 miles.

Whitefield & Jefferson.—It is intended to begin work on the extension of this road to Gorham, N. H., May 1.

Pemigewasset Valley.—There is talk of extending this New Hampshire railway from North Woodstock.

Baltimore & Ohio.—Surveys are now in progress for a line from West Newton, Pa., via Arona, Adamsburg, Penn and Jeannette to Punxsutawney, Pa., 90 miles.—About 300 men, with 6 locomotives and 16 steam shovels, are now at work on the Akron & Chicago Junction R. R. and it is expected to have the line completed within two months. The line is already completed between Chicago Junction and Warwick, O.

Philadelphia & Reading.—The Harrisburg Terminal R. R., running from Bowmansdale to Harrisburg, Pa., 8.76 miles, has been completed and will be opened for traffic May 1.—The contractors are on the ground ready to begin work on the extension from Bound Brook, N. J., to the Arthur Kill. It is intended to complete the line this season. It will cost about $1,000,000.

Mohawk Valley & Northern.—Sub-contracts will soon be let for constructing 40 miles of this line from Malone, N. Y., south. Work is progressing slowly on the Herkimer, Newport & Poland R. R., and surveys are now in progress from Poland through the Adirondack region to a connection with the line from Malone south. John W. Westbrook, 22 William St., New York City, is the general contractor.

Providence & Springfield.—The surveys have been completed for the line from East Thompson to Pascoag, R. I., 7 miles, and the estimates are now being made. The route is through a swampy and heavily wooded section of the state.

Projects and Surveys.

Syracuse & South Bay.—A press dispatch says.

The franchise for the proposed railroad from Syracuse to South Bay has been purchased by a New York capitalist, who will begin the work of construction soon. The amount required to build the road is about $250,000. The road is to be 13 miles long and of standard gage.

Southampton, Tara & Chatsworth.—Application has been made to the Dominion Parliament for a charter to build a railway from Chatsworth, Ont., via Tara, to Southampton, Ont., about 25 miles.

Bay Shore.—Articles will be filed with the Secretary of the State of Ohio, incorporating a railway company by this name. The capital stock is $60,000, nearly all of which has been subscribed.

Andover & Stafford Springs.—The preliminary survey has been made for a railway from Andover, Conn., to Stafford Springs, Conn.

New Boston.—A meeting will be held at New Boston, N. H., May 2, for the purpose of completing the organization of this company under the charter recently granted. Incorporators: Geo. A. Wason, Jas. R. Whipple and Butler T. Hills.

Chaudiere Valley.—This company has been chartered in the Province of Quebec, Canada. The object of the company is to construct a railway from a point in connection with the proposed St. Lawrence River bridge and a favorable deep-water terminus in or near the town of Levis, P. Q., up the Chaudiere River, comprising 6 miles of railway at present operated by John Breaky, to Scott's Junction, P. Q.; also to operate a line of steamboats in connection with the railway. John Breakey, P. Q., is interested.

New Glasgow Coal, Iron & Ry. Co.—This Nova Scotia company has completed arrangements for the construction of a short line of railway.

Saratoga & St. Lawrence.—A railway company by this name has been chartered in New York. The length of the line will be 8 miles, and the capital of the company is $80,000. The directors are: Ernest G. Reynolds, W. B. Babcock and Thomas A. Sears, of Bombay; Alfred A. Falton and Charles McConnell, Hogansburg; C. W. Breed, Frederick D. Kilburn, Orin S. Lawrence, Nelson W. Porter and Thomas Cantwell, Malone; Allen S. Matthews, Fort Covington; F. W. Baldwin, Ogdensburg, and E. C. Smith, St. Albans, Vt.

SOUTHERN.—Existing Roads.

Bristol, Elizabethtown & North Carolina.—It is stated that the money necessary to construct this road has been secured, and that work will be resumed at once

between Bristol and Mountain City, Tenn. Chief Engineer Geo. S. Bruce, Bristol.

Norfolk & Western.—The annual report of this company for the year ending Dec. 31, 1890, contains the following concerning the branches and extensions built during the year:

During the year 15.7 miles of short branches to coal and iron mines, 45.64 miles of siding and 31.4 miles of double track were constructed and put in operation. These later stretches run from Roanoke to Big Spring, 20 miles; Christiansburg to Radford, 13 miles, and Bluefield to Bluestone Junction, 13 miles, a total of 45 miles, of which, as stated, 31.4 miles are in operation. The second effect of this work is a reduction of maximum grade eastbound from 87 ft. per mile to 53 ft., and westbound 91 ft. to 70 ft. The remaining 46.5 miles of the Clinch Valley extension was practically completed, and will probably be in operation in May. On the North Carolina extension 15.41 miles were completed.

The double track of the road has been completed from Roanoke to Elliston, a distance of 20 miles. The section of road from Elliston to the top of the Alleghany Mountain, 11 miles, is not yet let to contract. It is very heavy work and will be commenced in the early spring.

An official sends the following:

The Clinch Valley Division of this railway extending from Graham, in the New River Division, to Norton has now been completed, the last rail being laid at the latter place on April 13, 1891, under the immediate direction of Mr. Emile Low, Engineer in Charge, C. V. Div. On this day 7,000 ft. of track were laid. This division is 100 miles long, and connects at Norton with the Louisville & Nashville R. R., which is building a road from Cumberland Gap to Norton, completing the missing link of a new trunk line from Louisville to Norfolk. The L. & N. R. R. expect to reach Norton about 1st of May. It is expected that through trains will run by June 1. The N. & W. R. R. is erecting a large passenger and freight station at Coeburn, the center of an almost inexhaustible gas-coal field controlled by the Virginia Gas Coal Co., whose mines are reached by the Little Tom Branch now under construction, the contractor being Mr. L. H. Vaughan, of Roanoke, Va.

Mobile & Ohio.—Bonds to the amount of $3,000,000 have been issued by this company to provide for the construction of a line from Corinth, Miss., to Birmingham, Ala. Preliminary surveys are now in progress.

Gulf & Ship Island.—W. H. Hardy, President, is reported as saying that the contract for the construction of this road from the end of track, 14 miles, north of Gulfport, Miss., to Hattiesburg, Miss., had been let to the Tobey Construction Co., of Chicago, the road to be completed by Sept. 1.

Roanoke & Southern.—The 60-mile section of this road between Winston-Salem, N. C., and Martinsville, Va., has been opened for traffic. About 20 miles of the grading from Martinsville north are completed, and tracklaying is in progress. From Roanoke, Va., south, grading is making good progress and tracklaying will soon begin. A branch will probably be built from Walnut Cove to Danbury, N. C.

Morristown & Cumberland Gap.—The contract for tracklaying on this railway from Morristown to Cumberland Gap, Tenn., has been awarded. The company will issue $1,000,000 of bonds to provide for construction expenses.

Kanawha & Michigan.—Surveys have been resumed on the Charleston & Gauley Branch, and it is stated that the line will be built this season.

Gainesville, Tallahassee & Western.—Grading is now well under way on this Florida railway between Gainesville and Monticello, Fla. John M. Cook is Chief Engineer.

Projects and Surveys.

St. Albans & Coal River.—It is reported that this company has let the contract for grading its line from St. Albans to Madison, W. Va., 42 miles, and that work will begin June 1. W. C. Reynolds, 232 Broad St., Charleston, W. Va., Chief Engineer.

Latta & Bennittsville.—The surveys for this railway have been completed between Latta and Dunbar, S. C., and are now in progress between the latter place and Bennittsville, S. C.

West Virginia, Alderson & Central.—Chartered in West Virginia to build a railway from the East River in Mercer Co., to some point on the Baltimore & Ohio R. R. Jas. H. Miller, Hinton, W. Va., is one of the incorporators.

Adel & Moultre.—Preparations are being made to build a railway from Adel to Moultre, Ga., 20 miles. The track will be standard gage. For the present the road will do a lumber business only.

Wheeling & Connellsville.—Chartered in West Virginia to build a railway from Wheeling, W. Va., to the Pennsylvania line, near Wheeling Creek, Marshall Co. The enterprise has been on foot for some time. The object of the road is to connect Wheeling with the Connellsville coal and coke fields. The incorporators are: Wm. A. Lynch, of Canton, O., and R. H. Cochran, F. J. Hearne, W. A. Isett, J. N. Vance, George Wise, A. J. Clarke, C. A. Robinson, John G. Hoffman, Sr., Henry K. List, Joseph Speidel, A. Reymann, J. B. Taney, E. W. Ogiebay, John Frew and W. P. Hubbard, all of Wheeling.

NORTHWEST.—Existing Roads.

Missouri Pacific.—Grading is making good progress on the cut-off, from Union to Plattsmouth, Neb., and tracklaying will begin as soon as the rails arrive.

Duluth & Winnipeg.—This company has secured the signatures of the Chippewa Indians to the sale of the right of way across their reservation, and it is stated that work will soon be resumed on the extension of the road.

Minneapolis, St. Paul & Sault Ste. Marie.—The Canadian Pacific Ry. Co. has obtained a loan of $21,000,000 for this company. Of the loan it is said that $14,000,000 will be reserved for the exchange of the existing bonds. The report is that the remaining $7,000,000 is to be used at once in the construction of an extension from Hankinson, N. D., to Regina, N. W. T. By the building of this line the Canadian Pacific would have a transcontinental route by way of St. Paul, which would be considerably shorter than the present one.

Canadian Pacific.—An agreement has been entered into between this company and the Manitoba Provincial Government whereby the company agrees to build 150 miles of railway mainly within the Province of Manitoba upon receipt of a subsidy of $1,000 per mile. The work comprises the extension of the Plum Creek Branch, from Hartney, Man., to the Souris coalfields, 120 miles, the extension of the Deloraine Branch to Melita, Man., 25 miles, and a 5-mile extension of the Glenbero Branch.

Chicago, Burlington & Northern.—This company will expend about $750,000 upon the improvement of its terminals at Minneapolis, Minn.

Projects and Surveys.

Chicago, Decatur & Eastern.—The surveys are nearly completed. The route is from Bernice to a connection with the Elgin, Joliet & Eastern R. R., at Bloom, Ill., about 12 miles.

Duluth, Red Lake Falls & Northern.—The route of this road as surveyed will run north of Leech Lake, crossing the Mississippi river, just south of Ball Club Lake, 10 miles north of Grand Rapids, Minn., and running directly east along the Mesaba range from range 25 to range 17. At this point it turns southwest striking the Lester River, about 10 miles from its mouth and following that stream to the lake coast.

Winnipeg & Hudson Bay.—This company has secured a cash bouns of $1,500,000 from the Province of Manitoba Canada, in aid of its proposed line from Winnipeg, Man., to Hudson Bay. Press dispatches state that 100 miles of the line will be built this year.

SOUTHWEST.—Existing Roads.

Williamsville, Greenville & Northern.—C. W. McCrea, of Cape Girardeau, Mo., Chief Engineer, writes us that all but one mile of the grading has been completed between Pine View and Greenville, Mo. The route is through a rough country; maximum grade, 3½% and maximum curve, 12°. The road penetrates a rich timber region, and its principal business will be in lumber and lumber products.

Kansas City, Fort Smith & Southern.—Reports indicates that this road will be extended south to Prairie Grove, Ark., this season.

Southern Pacific.—This company has completed surveys for a line of railway from Centreville, Tex., up the valley of the Medina River, 73 miles, to the Llano coal and iron fields. It is said that work will begin at once and the line completed by Sept 1.

Choctaw Coal & Railway Co.—Engineers of this company have completed the reconnoissance for the extension west from Fort Reno, Ind. Ter., to the Texas Panhandle. It is thought that a very favorable route can be secured.

Fort Worth & Rio Grande.—The contract for a 30-mile extension from Comanche to Brownwood, Tex., has been let to Hurley, Tierney & Lynch, work to be completed Aug. 1. Work will begin at once.

Little Rock & Memphis.—Construction is reported begun on the extension west from Little Rock, Ark., via Hot Springs, Ark., to the Indian Territory line, being built under the name of the Memphis, Little Rock & Pacific R. R. Contracts have been let to the Union Bridge & Iron Co., for the $300,000 bridge across the Arkansas River at Little Rock. H. A. Schwanecke, Little Rock, Chief Engineer.

Projects and Surveys.

Springfield, Sedalia, Marshall & Northern.—The directors are preparing to secure a charter authorizing the construction of this road from Springfield, Mo., north through Sedalia and Marshall. The survey has been completed as far as Urbana, 15 miles north of Buffalo, Mo., and will be completed to Sedalia, Mo., by June. The roughest portion of the line is now being surveyed, and it is thought that the heaviest grade will not exceed 60 ft. per mile. A. M. Nelson, Springfield, Mo., Chief Engineer.

ROCKY MT. AND PACIFIC.—Existing Roads.

Great Northern.—Burns & Chapman, the contractors for the Pacific extension, have about 300 men at work on the line. This force will be increased as soon as sufficient of the right of way has been cleared to enable the employment of more men. Tracklaying is in progress from Cut Bank Creek west, and the 50-mile division to Two Medicine, Mont., will be completed as soon as possible. The bridge across Cut Bank Creek will be 1,208 ft. long and 137 ft. high.

New Westminster & Southern.—This road has been completed and the line inspected by the Canadian Government officials.

Union Pacific.—It is stated that a satisfactory settlement has been made by this company with the contractors of the Portland & Seattle R. R., work upon which was discontinued last December. The company pays the sum due the contractors at that time, which amounts to $197,000. The old contracts are canceled and new ones made. It is thought that work will soon be resumed.

Northern Pacific.—It is stated that several branches and extensions of the recently purchased Oregon & Washington Territory R. R. will be built during the present season. The work includes the completion of that portion of the partly graded extension from Centralia to Gray's Harbor, Wash., from Montesano to Gray's Harbor. This work is to be completed July 28. The remainder of the work will be in the eastern part of the state, and will comprise an extension from Dayton to Creston, Wash., about 45 miles, a cut-off between Waitsburg, Wash., and the Eureka Flat branch at Riverside Station, about 20 miles, and an extension of the Athena branch to Weston, Ore. ——About 500 men are at work on the line from Chehalis to South Bend, Wash., 54 miles. Three miles of track have been laid this year. The work has been greatly delayed by the wet weather.

Sumpter Valley.—Grading will soon be resumed on this line from Baker City, Ore., through the Sumpter Valley, about 25 miles. The road penetrates a fine timber country.

Projects and Surveys.

Pacific Coast & Eastern.—Chartered in Oregon to build a railway from Winchester, Ore., west, across the Coast Range, to Millicoma, Ore., on the Coos River, opposite Marshfield, Ore. Surveys are now in progress, and it is intended to build the road this season. Incorporators: C. W. Sower, L. C. Carrigus, C. F. Miller and H. A. Moss.

Toledo, Little Falls & Eastern.—About $11,000 has been subscribed in aid of this railway company, recently incorporated in Washington.

Seattle, Tacoma & Eastern.—Incorporated in Washington to build a railway from Seattle, Wash., to Portland, Ore., passing through Tacoma, Wash. Among the incorporators are: F. H. Osgood, D. A. Baxter and R. C. Washburn.

Boulder Terminal.—Chartered in Colorado by J. M. O'Neill, E. J. Temple, Geo. S. Oliver and others to build a railway from Denver to Boulder, Colo. E. J. Temple is President and Geo. S. Oliver is Chief Engineer. Surveys have been commenced. Branches will be built to Ward and Lyons, Colo.

Idaho Falls, Salmon River & Puget Sound.—A company will soon be chartered to build a railway from Idaho Falls, Idaho, up Birch Creek and down the Lemhi and Salmon rivers to a connection with a railway to Puget Sound. Branches will be built from Salmon City and Lewiston, Idaho, into the Lost River country.

Oregon.—A company is to be chartered with a capital stock of $1,000,000, to build a portage railway around the Dalles of the Columbia River.

Whidby Island.—A project is being agitated to build a railway from Chicago landing, at the south end of Whidby Island, across the Saratoga Passage to La Conner, Wash., and thence to Sedro, Wash., about 60 miles. G. V. Calhoun, of La Conner, is interested.

CITY TRANSIT.

Electric Railways.—New lines or extensions of existing systems are reported as probable in the following places: Harrisburg, Pa., address the East Harrisburg Passenger Ry. Co.; Kansas City, Mo., address the Metropolitan Street Ry. Co., Covington, Ky.; Sharpsburg, Pa.; Sioux City, Ia., address the Sioux City Electric Ry. Co.; Houston, Tex., address H. T. D. Wilson; Ogden, Utah, address A. H. Swan; Raleigh, N. C., address the Raleigh Electric Street Ry. Co.; Iowa City, Ia.; Oakland, Cal., address J. W. Hearst; Springfield, Ill., address J. N. Baylies; Concord, N. H., address the Concord Electric Street R. R.; Asheville, N. C., address C. E. Wilson, of Calhoun; Ansonia, Conn.; Boulder, Colo.; Butte, Mont.; address W. McC. White; Annistown, Ala.; Mason City, Ia.

Yonkers, N. Y.—The Yonkers Surface R. R. Co. has petitioned the Common Council for right to change its power from horses to electricity.

Bethlehem, Pa.—The contract for constructing the line from this city to Allentown has been awarded to H. E. Crilly of the latter place.

Athens, Pa.—It is reported that a road will be built to Sayre and Waverly. A company for this purpose is said to have been formed with $30,000 capital, partly paid in.

Atlanta, Ga.—President Hurt, of the Atlanta & Edgewood St. Ry. Co., is reported to have said that double track electric lines will be built on several streets.

Indianapolis, Ind.—The Broad Ripple road has received a franchise and will be constructed by the Edison General Electric Co. The franchise calls for the completion of the line by Dec. 31.

Seymour, Ind.—The Seymour St. Car Co. want estimates on storage battery systems.

Baraboo, Wis.—A company is being organized by F. T. Brewster, H. J. Irwin, E. N. Marsh and others to build a road to Devil's Lake, a distance of 3 miles. The capital stock of the proposed company has been fixed at $35,000.

Los Angeles, Cal.—The contract for building a 24 mile system, including the steam and electric plant, has been let to the Pacific Milling Co., of San Francisco, at $700,000. The road will be known as the Los Angeles Consolidated Electric Ry. Co.

Alameda, Cal.—The Alameda, Oakland & Piedmont R. R. Co., Theo. Meetz, President, has received permission to change its motive power to electricity.

Cable Railways.—*Detroit Mich.*—There is some talk of operating two branches of the Detroit City Ry., by the Vogel system, illustrated in our issue of Jan. 31.

San Francisco Cal.—Plans are said to have been made for an extension of the McAllister St. Cable Line.

Horse Railways.—New lines or extensions are reported as probable in the following places: Washington, D. C., address the Anacosta & Potomac Ry. Co.; Santa Cruz, Cal., address F. H. Parker; Toledo, O., address the Consolidated Street Ry. Co.; Melrose, Mass.; Sacramento, Cal., address R. S. Carey; Eugene, Ore.; Bridgeport, Conn.; Worcester, Mass., address the North End Street Ry. Co.; Edgartown, Mass.; Oakland, Cal., address E. P. Vandercook.

Toronto, Ont.—The amount the city is to pay the Toronto Street Ry. Co. for its plant has been fixed at $1,453,788.

Dummy Railways are reported as probable in the following places: Asheville, N. C., address the Asheville & Weaverville Dummy R. R. Co.; Blountsville, Ala.; New Birmingham, Tex., address the New Birmingham Iron & Land Co.; Keltys, Tex., address the Angelina County Lumber Co.; Chopin, La., address the Cane River Lumber Co.

Gaffney City, S. C.—Stacey & Pegues desire bids for furnishing the following material at this city: T rails, fish bars, spikes and six switches for 2¼ miles standard-gage line; one passenger car, four flat cars of 17,500 lbs. capacity, one dummy engine.

Lutherville, Ga.—W. H. Albright is interested in the project to build a dummy line from Lutherville to Moreland a distance of six miles.

Amadee, Cal.—The Alteras *New Era* reports the organization of a company to construct a line from Susanville to this place.

New Companies.—Fall River, Mass., Electric Freight Ry. Co., capital stock, $500,000; directors, A. A. Glasier, F. L. Ames, T. J. Coolidge, Jr. Painesville, Fairport & Richmond Street Ry. Co., Painesville, O.; capital stock, $50,000. Sandusky, Ashland & Southern Ry. Co.; capital stock, $50,000. Citizens' Electric Ry., Light & Power Co., Mansfield, O.; capital stock, $125,000. Atlantic City Beach R. R. Co., Atlantic City, N. J.; capital stock, $10,000; incorporators, A. A. McLeod and C. H. Quarles, of Philadelphia; H. C. Felton and C. H. Davies, of Camden, and others. Four Lakes Transportation Co., Spokane, Wash.; capital stock, $200,000; incorporators, A. N. Garrett, R. Abernethy, L. B. Cornell. Seymour, Ind., Street Car Co.; capital stock, $30,000; President, A. M. Beatty. Bethlehem & Allentown Rapid Transit Co., Bethlehem, Pa.; capital stock, $1,000,000; directors, G. H. Campbell, W. Coffin, E. S. Webster and others. Pulaski Heights Land Co., Little Rock, Ark.; capital stock, $150,000. Denver, Colo., Circuit Ry. Co.; capital stock, $500,000. Butte, Mont., Consolidated Ry. Co.; capital stock, $500,000.

HIGHWAYS.

New Jersey.—The Hudson Co. Board of Chosen Freeholders has approved the plans of Chief Engineer Edlow W. Harrison, and has filed a map of the new county boulevard, for the construction of which $1,000,000 was appropriated by the legislature of 1890. The road will be 14 miles long and 100 ft. wide. It will run from the Kill von Kull to Bergen Co. Work will begin next fall. The county will by that time have acquired the property.

Pennsylvania.—The Birmingham & Brownsville Turnpike Co., of Pittsburg, has elected William Cowan, President; T. A. Noble, Secretary. A resolution was passed bonding the company's franchises to the extent of $30,000, to meet the expenses of paving to the city line.

Delaware.—The Park Commission of Wilmington has awarded a $15,000 contract to T. H. Connell, of Philadelphia, for a boulevard 6,000 ft. long and 150 ft. wide, with 2 macadamized driveways 20 ft. wide.

Massachusetts.—The town of Dartmouth has appropriated $4,000 for a macadamized road on Smith's Neck to Nonquit. The Selectmen will borrow the money.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Glasgow, Va.*—A bridge 250 ft. long will be built across North River at this place. J. W. Gerow, Norfolk, Va.

St. Louis, Mo.—It is probable that the present wooden bridge across the railway tracks at Twelfth Street will be replaced by stone arches. It is estimated that such a structure would cost about $180,000.

Tunnels.—Application has been made to the Ontario legislature for an act to incorporate a company with power to construct tunnels suitable for railroad purposes from the towns of Windsor and Sandwich, and townships of Sandwich East and Sandwich West, in Essex Co., Ont., under the Detroit River, westerly to the boundary line of the Dominion.

Canals.—It is reported that work will soon begin on a portion of the proposed Hennepin Canal, connecting Lake Michigan with the Mississippi River. Five miles of the canal between the rapids of Rock River and the Mississippi have been located and it is stated that contracts will be let soon. The initial appropriation by the government is $500,000.

The Delta Canal Co. has been chartered in Florida to build a canal from Lake Apopka, through Little Lake Harris, to Lake Griffin, 6 miles. Capital stock, $50,000. Incorporators: L. H. Davis, A. R. Swoope, J. M. Bryan, J. M. Wilcox, Jr., and Cecil Butt.

WATER-WORKS.

NEW ENGLAND.

Franklin Falls, N. H.—The contract for building the reservoir has been awarded to J. H. Fuller, Lowell, Mass.

Lancaster, N. H.—Arrangements are being made by the Lancaster Water Co. for the construction of a 1,750,000-gall. reservoir.

Middlebury, Vt.—Lang, Goodhue & Co., Burlington, Contractors, have begun the construction of works. Pipe has been bought.

Boston, Mass.—The local papers are discussing an additional supply. New pumps, with a capacity of about 20,000,000 galls., for the Chestnut Hill station, are under consideration. A break in one of four pipes forming an inverted siphon in the Cochituate aqueduct, at Newton Lower Falls, occurred on April 19. It is reported that it was caused by an unauthorized private roadway over the aqueduct. It is stated that the break was near a serious one which occurred March 29, 1859.

Easthampton, Mass.—John Mayher, Chairman water committee, informs us that a legislative committee has reported favorably on the petition for authority to increase the supply by piping water from springs on Mt. Tom to a reservoir.

Falmouth, Mass.—The bill authorizing the shareholders in the Falmouth Highlands Trust to supply Falmouth from Long Pond has passed the Legislature. George W. Parke and W. G. Fish are Trustees. G. W Parke, 27 School St., Boston has sent the following:

The contracts will probably not be let until October next. Water will be pumped by steam or a hot-air engine, to a reservoir. Estimated cost $10,000. Population, 1,000.

Great Barrington, Mass.—P. A. Russell is one of the newly elected Water Commissioners. The commissioners have been authorized to apply for authority to extend the works.

Lynn, Mass.—A $50,000 4½, 20-year water loan has been ordered.

Methuen, Mass.—The legislative committee on water supply has reported a bill authorizing the people to vote $150,000, 6% bonds, for a new supply from bored, driven or artesian wells.

Milford, Mass.—On April 27 a vote will be taken on the purchase by the town of the works of the Milford Water Co.

Waltham, Mass.—It is reported that an unusual length of distributing mains will be laid this year.

Worcester, Mass.—About 3,500 ft. of 6 and 8-in. mains have been ordered laid.

Naugatuck, Conn.—E. C. Barnum, Secretary, informs us that the company wishes bids for constructing a dam 25 or 30 ft. high and between 200 and 300 ft. long. Plans and specifications can be seen at the company's office.

Woonsocket, R. I.—A bill has been introduced in the Legislature authorizing the city to borrow $100,000 for water-works extensions.

Wallingford, Conn.—The estimated cost of a new 12-in. supply main 23,700 ft. long, from Paugh Pond, is about $31,000. The Water Commissioners, including W. J. Morse, Superintendent, and others, will investigate the matter of a new supply.

MIDDLE.

Albany, N. Y.—The Council has adopted a report recommending that gagings of the flow of the Normanskill, the proposed source of supply, be made this summer.

Ballston Spa, N. Y.—Village President Comstock advocates the replacing of the wrought-iron and cement distributing mains with larger cast-iron mains at an estimated cost of nearly $100,000.

Mayville, N. Y.—The following is from P. E. Leet, Secretary Water Commissioners:

The question of building works, estimated to cost $10,000, will be submitted to the people at an early day. It is proposed to pump water from Chautauqua Lake to a tank. A. A. Van Dusen is Chairman of the Commissioners, and L. B. Bixby is Engineer.

Newburg, N. Y.—A 1,000,000-gall. reservoir is to be built, it is reported.

Rouse's Point, N. Y.—E. C. Earnest, Village Clerk, has sent the following:

An additional pump and an extension of the mains will be made, provided the legislature authorizes the village to issue bonds to 15% of assessed valuation, instead of 10%, as at present.

Schenectady, N. Y.—E. M. Jenkins, President of the Water Commissioners, informs us that the Council will probably act upon the plan for a new water supply next week. The plan, slightly abbreviated from the Commissioner's report of April 14, is as follows:

A well, or wells, on Van Slyck's Island or on the adjacent main land; a new pump house and the abandonment of the present pumping station; the connecting of the wells to the new pump house by a 30-in. suction pipe, together with an independent line of the same size to the Frog Alley River; a 24-in. force main from the new pump-house under and along the river road, Dock and State Sts., to and connecting with the 10-in. crosstown main through Centre St; the substitution for the present pumping machinery of two high duty vertical pumps of 5,000,000 galls. daily capacity. Estimated cost, $154,000.

Altoona, Pa.—Paul Krenzpointner informs us that the people will vote in the latter part of May, on the expenditure of $220,000 for increasing the water supply. Various plans have been proposed. The Board of Trade has appointed a committee to consider the matter, which has elected Thomas McKiernon, Chairman, and H. B. Kendig, Secretary.

Bridgeport, Pa.—Howard E. Ahrens, Reading, has the contract for the reservoir, which will be 133 × 138 ft. × 13 ft. deep, lined with brick.

Lancaster, Pa.—It is reported that C. B. Brush, Hoboken, N. J., will be employed to report on the proposed new reservoir.

SOUTHERN.

New Berne, N. C.—The New Berne Water-Works Co. has been incorporated by G. E. Ladshaw, Spartanburg, S. C., H. H. Leftwich and J. A. Bryan; capital, $40,000.

Atlanta, Ga.—Superintendent W. G. Richards and City Engineer R. M. Clayton have completed a survey and made plans for a new supply from Chattahoochee River. They propose to dam the river to obtain a head to lift water 285 ft. to a second pumping station and to generate electricity to light the city and to drive the pumps in the second station, where the lift will be slight.

Carrollton, Ga.—It is reported that Henry Lanier has authority to dispose of a franchise for works.

Alexandria, La.—Address the mayor regarding works.

Jasper, Tenn.—The following is from W. C. Smith:

No water company has yet been organized. Two large springs on the mountain would furnish an ample gravity supply. Address S. C. Barber. Population, 1,200, which will be immediately increased by new industries.

Sequachee, Tenn.—G. Sherman has received from the Town & Improvement Co. the contract for works.

Union City, Tenn.—The Mayor has sent the following:

The city has been authorized to issue $60,000 of bonds for water-works and electric light plants, but the matter must be submitted to a popular vote. The Mayor and Council may yet conclude to grant a franchise. The question will not be settled for several weeks.

Shelbyville, Ky.—It is reported that a proposition to build works has been made by G. W. Sturtevant, Jr., Minneapolis, Minn.

NORTH CENTRAL.

Cincinnati, O.—A house bill authorizing the construction of new works has passed the Senate with some amendments. It provides for a popular vote on the question, after which, if it is sustained, the mayor shall appoint a non-partisan board of four, who shall construct the works, and issue bonds up to $5,000,000 to pay for the same. At last reports the House had not concurred in the amendments.

Van Wert, O.—J. W. Hill, Cincinnati, informs us that the contract for pumping machinery was awarded to the Holly Manufacturing Co., Lockport, N. Y., for $12,966.

Holland, Mich.—O. E. Yates, Mayor, informs us that the city proposes to lay 4½ miles of 8 to 4-in. pipe, and will probably ask for bids soon.

Hinsdale, Ill.—Henry Spencer informs us that bids for constructing the works have been received as follows: G. C. Morgan, Chicago, $33,998; G. McIntosh, Bloomington, $31,871; W. S. Parker & Co., Pontiac, Mich., $36,000; James Madden, Ft. Wayne, Ind., $36,450.

Rogers Park, Ill.—The Rogers Park Water Co. has increased its capital stock from $50,000 to $100,000.

NORTHWESTERN.

Grinnell, Ia.—J. R. Lewis has sent the following:

Works estimated to cost $20,600 are projected by the city. The source of supply has not been determined, but probably water will be pumped to a stand-pipe. Capital for construction has not been secured. Population, 3,300.

New Hampton, Ia.—L. L. Briggs informs us that the contract for works has been let to Fairbanks, Morse & Co., Chicago, for $6,595. Also that there will be an elevated wooden tank and 3,700 ft. of 4 and 6-in. mains.

Sheldon, Ia.—The following is from H. W. Conant, City Clerk:

An attempt is being made to get a company to build works. The proposed supply to be pumped from driven wells at the river to a stand-pipe. Estimated cost, $20,000. John Bowley is Mayor. Population, 2,000.

Storm Lake, Ia.—The following is from James DeLand, Recorder:

Bids are wanted until May 4, separately, or in bulk, for a 5000,000 gall. compound duplex, or a simple duplex pump, a 60 HP. boiler, 24 × 38 ft. boiler house, filter and connections, about 11,500 ft. of 8 to 4-in. pipe and laying same, 19 hydrants and 12 gates. Mayor, J. P. Morey. Water will be pumped from a lake. Population, 2,000.

Ponca, Neb.—At a special election a majority of 15 were in favor of works.

Butte, Mont.—J. H. Harper, City Engineer, informs us that the Silver Bow Water Co. has made another proposition to the city, and that an opportunity has been given for other companies to make offers. According to the *Inter-Mountain*, the works of the Silver Bow Water Co. and the rights of the Summit Valley Water Co. have been bought by the Butte City Water Co., which will at once construct a $2,000,000 plant. J. A. Coram may be addressed. A somewhat extended account of the various projects for supplying the city was given in our issue for Feb. 28, 1891, p. 194.

SOUTHWESTERN.

Aurora, Mo.—The people have voted for works.

Fort Worth, Tex.—The city's new charter authorizes water-works and general improvement bonds to the amount of $1,000,000.

Llano, Tex.—W. W. Knowles & Son inform us that the time for beginning to enlarge their works depends upon local matters. Pipe and a water-power pump will be bought.

Waco, Tex.—The Waco Water & Light Co. has published a notice to the effect that it will sink new artesian wells and extend its mains.

Highlands, Col.—It is reported that the reservoir will be cemented, a stand-pipe built in connection with it, a new supply main added, and wooden pipe be replaced with iron. The works are now owned by the Denver City Water Co.

PACIFIC.

Seattle, Wash.—An independent system is proposed for a suburb named Columbia, the supply to be from a stream of spring water.

Sidney, Wash.—J. P. Thomson, Seattle, informs us that the matter of water-works has been postponed.

South Aberdeen, Wash. (Aberdeen P. O.)—The Sunset Light & Water Co. is preparing to build works to supply South Aberdeen.

Portland, Ore.—Bids are wanted for 926 tons of pipe for distributing mains. Surveys for the new Bull Run supply main are to be made at once.

Eureka, Cal.—The Fire and Water Committee wishes plans and specifications for a fire protection, street-sprinkling and sewer-flushing system, salt water to be pumped from Humboldt Bay. It is estimated that 22 hydrants will be needed and that the works could be built for $10,000. The Ricks Water Co. supplies the city.

Oakland, Cal.—The new 4,000,000-gall. Hyatt filter plant has been successfully tested.

San Luis Obispo, Cal.—The company is making ready to lay a new 14-in. supply main.

Stockton, Cal.—The new company will extend the distributing system, erect a stand-pipe and add six 10-in. wells. W. S. McMurty, Los Gatos, is at the head of the enterprise.

Boise City, Ida.—Alfred Eoff, Secretary, Boise City Water-Works Co. has sent the following:

The above company and the Artesian Land & Improvement Co. have consolidated as the Artesian Hot & Cold Water Co., Limited, with a capital stock of $250,000. The details of transfer of stock and organization have not been completed.

CANADA.

Toronto, Ont.—The sub-committee on tenders has recommended that the bid of the G. F. Blake Manufacturing Co. to furnish a 10,000,000-gall. pumping engine for $54,418 be accepted.

St. Thomas, Ont.—A 1,000,000-gall. Hyatt filter plant has been put in operation.

ARTESIAN WELLS.

Pittsburg, Pa.—A movement is on foot to secure from the Council authority to sink numerous wells in the south part of the city, the expense to be met by those benefited, J. Schneider is interested.

Graham's, S. C.—A well is projected.

Hubbardston, Mich.—An attempt will be made to secure a flowing well.

Harvard, Ill.—The well is down over 1,000 ft., and water is within 3 ft. of the surface.

Bastrop, Tex.—A well is to be sunk for the water supply.

Corsicanna, Tex.—The Legislature has appropriated $8,000 for securing artesian water at the State Orphan Asylum.

Denison, Tex.—The sinking of a 1,000-ft. well at the pumping station has just been started.

Ft. Worth, Tex.—The well is down 2,200 ft., and a supplemental contract has been made by the city to sink it 500 ft. deeper, or less.

Henrietta, Tex.—A well 2,500 ft. deep, if necessary, will soon be sunk by the Improvement Co.

Ladonia, Tex.—The citizens wish to have a well sunk.

Roswell and Eddy, N. M.—Contracts for five wells in the Pecos Valley, near these towns, have been let.

Modesto, Cal.—The Odd Fellows have projected a well.

IRRIGATION.

Miles City, Mont.—The Miles City Irrigating & Ditch Co. have decided to begin the construction of a 6-mile ditch. W. N. Haynes is General Manager.

Missoula, Mont.—The Missoula Realty Co. proposes to build a dam in Hellgate Cañon, and dig a ditch. Surveys are being arranged for.

North Yakima, Wash.—The Northern Pacific & Yakima Irrigation Co. has begun the construction of irrigation works, estimated to cost, finally, $3,000,000. It is said that the main canal will be 50 miles long, 30 ft. wide at the bottom, 60 at the top and 8 ft. deep. It is reported that W. H. Hall, San Francisco, Cal., is Engineer for the work, and that A. Katz has the contract for the first 25 miles of the canal.

Modesto, Cal.—The Modesto Irrigation District wishes bids for the construction of a dam.

Oakdale, Cal.—The Oakdale Irrigation Co. is making surveys for a branch to its canal.

Pixley, Cal.—There is talk of organizing a district comprising about 100,000 acres, under the Wright irrigation act.

Selma, Cal.—The Sunset Irrigation district has elected Philip Dengler, President, and Milton McWhorter, temporary Secretary. Surveys for a canal will be made.

New Companies.—The following companies have been incorporated, the figures representing capital stock and the names, incorporators: Free Church Lateral Ditch Co., Greely, Col., $1,950; High Meso Ditch Co., Montrose, Col., $2,000; A. L. Bonney, E. E. Young. Blue Mountain Irrigation & Improvement Co., Pendelton, Ore., $80,000; Lot Livermore, J. H. Raley. Umatilla Improvement Co., $1,000,000; N. G. Blalock, C. J. Smith, R. J. Slater. Campbell & Moreland Ditch Co., Visalia, Cal., $12,800; C. T. Brown, O. E. Gibbons.

SEWERAGE AND MUNICIPAL.

Sewers.—*Maine.*—Oldtown proposes to have a sewerage system.

New Hampshire.—A special committee has procured the necessary legislation to allow Laconia to establish a sewerage system and to fund its indebtedness.

Massachusetts.—Middleboro has made an appropriation of $20,000 to commence its sewer system.—Falmouth. A system of sewerage is to be built. Address Mr. Geo. W. Parke, Boston.—Lowell. The Sewer Committee proposes to have the work done by day labor and has instructed Superintendent Beals to procure the necessary material.

New York.—Nyack is about to appoint a sewer commissioner under the new law to lay out a general system, and the amount of money to be expended is to be decided by public vote.—White Plains has appointed the village president, coporation counsel and a civil engineer, a committee to examine the sewerage systems of Worcester, Mass., and Newport, R. I.—Hornellsville. A law has been passed authorizing the construction of sewers.—Auburn. New sewers are needed, and the present ones require some means of flushing.

New Jersey.—The South Orange Trustees have passed an ordinance providing for the construction of a system of sewers at a cost of $60,000. The system will include disposal works at Springfield, where a farm is to be purchased, the village having an option on it for $13,500. The system of filtration and disposal will be similar to that now in use in East Orange. Mr. Bassett, the engineer of the East Orange system, who has been engaged to superintend the construction of the sewerage system for Orange, which is to cost from $400,000 to $500,000, will also be the engineer for the South Orange works. It is probable that the villages of Maplewood and West Orange will try to connect with the South Orange sewerage system, the grade being favorable for such a plan. It is also not unlikely that the Orange Valley district of the city of Orange may be connected with it, as that would probably be a cheaper and more satisfactory plan for Orange to dispose of the Orange Valley sewage than by the use of a pumping station, as is contemplated in the Orange plans.—Bridgton. The committee on sewers has been authorized to engage Mr. Rudolph Hering, Mr. Howard Murphy and Col. Geo. E. Waring to examine and report upon a system of sewers.—Somerville has its system of sewers completed; there are 3½ miles of sewers, and the cost will be about $18,000.

Virginia.—Roanoke. The sewer committee of the City Council has received the preliminary report of Mr. Hering for the plans for sewering the central part of the city. This plan is for draining that part of the west of Lick Run to the water shed, extending a few hundred yards east of Park St. The plan provides for a large intercepting sewer. The merits of the West sewerage system have been presented by Mr. John J. Deery, of the National Sewerage & Sewage Utilization Co., of New York.

Ohio.—Painesville. Petitions are being circulated for about 1 mile of sewers to be built this season.—Bellaire will expend $15,000 in the sewerage of the 5th Ward.—Ironton. The city engineer has prepared a report on and plans for a "separate" system of sewerage.

Illinois.—Roseland desires a connection with the Pullman sewers, or an independent system.—Sycamore. A system of sewers is projected.

Iowa.—Burlington. Mr. Steyh, City Engineer, in his annual report, states that the city is behind others of equal size as regards its sewers.

Missouri.—Joplin. A complete system of sewerage is to be constructed.

Texas.—Dallas. Mr. D. A. Poynor, City Engineer, states that the city has outgrown the old system, and that about 30 miles of sub-mains and laterals are required. He suggests an examination by an expert sewerage engineer.

Washington.—Spokane Falls. About 4,680 ft. are now under construction, and will be completed by May, being part of the system built last year. A number of extensions will be built.

Nevada.—Carson City will build a system of sewers, including 25,000 ft. of 8-in. vitrified pipe, 5,000 ft. of 8 and 10-in., and 5 flush tanks. The cost will be about $25,000.

Streets.—*Maine.*—Portland. The city engineer has reported that the asphalt pavement laid last year by the New England Paving Co. has given very satisfactory results.

Massachusetts.—Boston. It is proposed to borrow $3,000,000 for street work. Commonwealth Ave. is to be extended from Beaver St. to the Chestnut Hill reservoir at a cost of $863,000; it will be 160 ft. wide.

New York.—Tonawanda. Improvements in street paving are projected.—Jamestown. The council has authorized the Board of Public Works to report upon a system of paving.—Olean. A bill providing for street paving has passed the senate.

District of Columbia.—The District Commissioners' Washington, will advertise for proposals for 160,000 vitrified paving brick.

Louisiana.—At New Orleans a considerable amount of gravel paving is being done by the Rosetta Gravel Co.

Illinois.—Rockford. North Main St. is to be paved with brick at an estimated cost of $1.50 to $1.60 per sq. yd.

Minnesota.—Winona. The Street Committee has recommended cedar block paving.

Bonds.—Tonawanda, N. Y.; $40,000 for paving. Bedford City, Va.; $25,000 for streets. South Bend, Ind.; $50,000 for streets, bids to be opened April 27. Dayton, O.; $35,000 for se vers; bids to be opened May 15. Denver-Col.; $40,000 for sewers. Middleboro, Mass.; $20,000 for sewers. Detroit, Mich.; $200 000 for boulevard. Fort Edward, N. Y.; $20,000 for paving. Waco, Tex.; $40,000 for sewers. Eugene, Ore.; $20,000 for sewers. Roseburg, Ore.; $25,000 for sewers. Newport, R. I.; $70,000 for sewers and street improvement, sold to Brewster, Cobb & Esterbrook, of Boston, at $73,237. West Troy, N. Y.; $50,000 for paving; sold to Lake Bros. & Co., of New York. Carson City, Nev.; $25,000 for sewers.

Gas.—*New York, N. Y.*—The Gas Commission has received the following bids for lighting the city's gas lamps from May 1 to Dec. 31: Equitable Gaslight Co., $8 per lamp; Standard Gaslight Co., $8.695 9; Consolidated Gas Co. $11.66⅔; New York Mutual Gaslight Co., $11.67; New York & New Jersey Globe Gaslight Co., $14.75; Central Gaslight Co., $18; Northern Gaslight Co., $18.64; Yonkers Gaslight Co., $18.66⅔.

Drainage.—The proprietors of the Tantramar marsh at Sackville, Nova Scotia, propose to dig 3 drainage canals this summer at a cost of $10,000 to $30,000.

ELECTRICAL.

Electric Light.—New plants or extensions of existing systems are reported as probable in the following places: Rockport, Me., address L. C. Christian; Gilroy, Cal.; Highlands, Colo., address F. P. Arbuckle; Uniontown, Ala.; Fremont, Neb., address F. L. Burrell; Vassar, Mich.; Marshfield, Ore., address the Electric Light & Power Co.; Roanoke, Va., address E. B. Fisher; Richlands, Va., address the Richlands Water, Electric Light, Gas & Power Co.; Warrenton, Va.; Caribou, Me., address the Caribou Water Co.; Livermore, Cal.; Wayville, N. Y.; Morris, Ill.; Oneonta, N. Y.; Warren, R. I.; Central Falls, R. I.; Watkins, N. Y., address A. A. Cowing; Ridley Park, Pa.; Alliance, O.; Morning Sun, Ia.; Albia, Ia.

La Grange, La.—It has been decided by popular vote to issue bonds for the construction of water-works and an electric light plant.

Covington, Ky.—The Covington Electric Light Co. offers to furnish 2,000 c. p. lights on a 25-year contract at $10 a month for all night and $8.25 for moonlight service. They also offer incandescent lamps at $20 each per year on an all night or $18 on a moonlight schedule.

Omaha, Neb.—The Ballou Electric Co. has received permission to lay both underground and overhead wires provided it expends $50,000 the first year. The company is to furnish the city with 100 lights of 2,000 c. p. at $125 each per year.

Vallejo, Cal.—Bids for supplying 2,000 c. p. lights for street illuminating on a 5-year contract are wanted by H. L. Lazelle, City Clerk. Bids received until May 15.

Chico, Cal.—The Chico Gas & Electric Light Co. has contracted to supply thirty 2,000 c. p. lights, burning until midnight, at $10 each per month.

Seattle, Wash.—A municipal lighting plant costing $75,000 is under discussion here.

New Companies.—Whitehall Electric Light & Power Co., Whitehall, N. Y.; capital stock, $50,000; incorporators, W. D. Rich, H. R. Gardner, F. Fishler. Watkins, N. Y., Electric Light & Power Co.; incorporators, C. E. Taber, A. A. Couring, J. H. Drake. Western Water & Electric Light Co., McPherson, Kan.; capital stock, $25,000. Windsor, Mich., Electric Light & Power Co.; capital stock, $25,000; incorporators, W. C. Nash and others. People's Electric Light, Heat & Power Co., Greenville, Pa.; capital stock, $25,000. Edison General Electric Co., Santa Fè, N. Mex.; incorporators, J. S. Decker. W. A. Williams, W. S. Perry and others. Potomac Electric Co., Washington, D. C.; capital stock, $25,000; incorporators, J. C. O. Gorman, and M. O'Donnell, of Stillwater, Minn., H. P. Gilbert, G. W. Laird and others. Arc & Incandescent Light Co., San Francisco, Cal.; capital stock, $100,000; directors, J. P. Martin, F. M. Pickering, A. J. Bowie. Yoakum Tex., Electric Light & Ice Co.; capital stock, $50,000. Downer's Grove, Ill., Electric Light Co.; capital stock, $250,000; incorporators, E. G. Foote, C. F. Linscott E. H. Prince. Bay City Gas, Water & Electric Works Lodi, Cal.; capital stock, $100,000; incorporators, G. G. Buckland, J. D. Fisk, S. T. Dodson. Ruby City, Wash., Water, Light & Power Co.; capital stock, $100,000; incorporators, S. Litchenstadter, J. R. Reavis, A. V. Garrett. Royersford, Pa., Light, Heat & Power Co.; capital stock, $1,000; President, S. H. Egolf. Americus, Ga., Illuminating & Power Co.; capital stock, $100,-

000. Wallace Mfg. Electric & Water Co., Wallace, Idaho; capital stock, $50,000. Capital Electric Light, Motor & Gas Co., Boise City, Idaho; capital stock, $20,000. Montauk Electric Co., Brooklyn, N. Y.; capital stock, $50,000. Gansvoort Electric Light Co., Rome, N. Y.; capital stock, $10,000. Whitehall, N. Y., Electric Light & Power Co.; capital stock, $50,000. Knoxville Schuyler Electric Light & Power Co., Knoxville, Tenn; capital stock, $40,000. Payson, Utah, Electric Light & Power Co.; capital stock, $6,000. Cooper-Hampton Electric Co. Minneapolis, Minn.; capital stock, $2,000,000.

CONTRACTING.

Sewers.—*Marion, O.*—The following proposals were received April 14 by Mr. John W. Hill, Consulting Engineer, Cincinnati, O. The bidders were as follows: A, Walker & Walker, Cincinnati, O.; B, Irwin & Maher, Greenville, O.; C, Merril & Reinhard, Cleveland, O.; D, Wilson & Strack, Cincinnati, O.; E, Fred Groch, Sandusky, O.; F, Palmer & Bibbitt, Columbus, O.; G, Patrick Murray, Cincinnati, O.; H, James McQuade, Pittsburg, Pa.; I, Boughen Engineering Co., Cincinnati, O.; J, W. H. Louthan & Co., Hamilton, O.; K, McPolland & Graham, Pittsburg, Pa. Bids D, H and K were informal:

lin. ft. for straight and circular curb, 60 cts. per sq. ft. for crosswalk, $100 for receiving basins. Maiden Lane, R. H. Strong; $6.08 per sq. yd. for paving, $1.50 and $1.80 per ft. for curb, 45 cts. for crosswalks, $7 for manholes, $83 for basins.

Kearny, N. J.—P. H. Harrison has a contract for 3½ miles of grading and macadamizing, at 30 cts. per cu. yd. for excavation, and $1.05 per yd. for macadam.

Savanah, Ga.—The contract for 11,000 sq. yds. of asphalt paving on Bull St. has been awarded to the Warren Scharf Asphalt Paving Co., of New York, at $3.25 per sq. yd. T. A. Huguenin, of Charleston, S. C., bid $2.25 per sq. yd. for asphalt blocks.

Pipe and Laying.—*Kearny, N. J.*—A contract for 10,000 ft. of 6 and 8-in. water pipe has been awarded to M. O. Drummond at $27.75 and $27 per ton. P. H. Harrison has the contract for pipe laying at 28¼ cts. per ft.

Jetty.—The contract for jetty at the entrance to Cumberland Sound has been awarded by Capt. O. M. Carter, U. S. Engineer Office, Savannah, Ga., to J. F. Gaynor, of Fayetteville, N. Y., at 97 cts. per sq. yd. for brush mattresses, and $3.49 per cu. yd. for rip rap stone. Total $107,830.

are to be enlarged. The Tubular Car Co. will build works near Bradford, Pa. The Steinhilber Combination Car Co., of Chicago, Ill., has been incorporated by Wm. Fuller, M. B. Mills and George A. Fuller; capital stock, $500,000.

Car Heating and Ventilation.—The Safety Heating Co. is forwarding the equipment for the second lot of 50 cars of the New York, New Haven & Hartford. It is all placed underneath the car, in connection with the Baker heater, so that no live steam is admitted to the car. The Emerson Car Ventilator Co., of Charleston, S. C., has a contract to fit its ventilator on some cars of the Georgia Central.

Railway Shops.—The Boston & Albany and New York & New England will build freight depots and a roundhouse at Springfield, Mass.

Drills.—Steel rock drills for phosphate rock and sandstone are wanted by the Hamburg Phosphate Co., of Tomkinsville, Fla.

The Hyatt Pure Water Co. will on May 1 consolidate its executive, drafting and manufacturing departments in its new quarters at 224 Market St., Newark, N. J.

	Sewers, linear feet.			Subsoil drain.			Excavation per linear foot for depth in feet of—						Rock, trench.	Sheeting, B. M.	Paving, broken stone.	Manholes, brick.	Concrete.	Castings.	Lampholes.	Flush tanks.	Iron pipe.	Masonry.	
	15-in.	8-in.	6-in.	10-in.	6-in.	Broken stone.	6 to 8.	8 to 10.	10 to 12.	12 to 14.	14 to 16.	16 to 18.											
	3,859.3 100 Y's.	7,776.6 388 Y's.	588 26 Y's	Lin. ft. 4,515.3	Lin. ft. 9,092.6	Cu. yd. 1,273	2,864 25	3,235.55	1,810.10	3,048.1	900.0	1,750.0	Cu. yds. 2,169.60	.....	Cu. yds. 500	20,616	C. yd. 41,713	Lbs. 24,367	34	9	25.08	Cu. yd.	
	$	$	$	Cts.	Cts.	$	$	$	$	$	$	$	$	$	$	$	$	C s.	$	$	$	$	$
A	0.45	0.23	0.20																				
	1.10	0.50	0.35	18	12	0.90	0.45	0.55	0.65	0.75	0.85	1.00	0.60	10	0.90	18.00	3.50	3½	3.00	35	35	4.00	20,443
B	0.41	0 15	0.10																				
	1.80	0.75	0.48	15	10	0.95	0.23	0.30	0.64	0.78	0.90	1.65	3.00	20	0.80	14.00	10.00	3	5.00	20	50	8.00	23,811
C	0.5250	0.235	0.19	Drain	tile.																		
	1.99	0.85	0.61	12	8	1.25	0.305	0.395	0.48	0.595	0.695	0.80	2.90	22	1.50	18 70	5.00	3½	4.00	35	43	7.80	24,144
D	0.70	0.32	0.26																				
	.....	.....	.....	25	14	2.50	0.35	0.45	0.60	0.80	1.00	1.40	1.00	20	2.00	20.00	6.00	3	1.60	45	40	5.00	26,655
E	0.4375	0.1575	0.105																				
	1.97	0.71	0.47	13	6	1.50	0.50	0.65	0.85	1.10	1.50	2.00	2.25	30	0.90	13.00	4.30	3½	1.00	30	40	8.00	27,682
F	0.45	0.19	0.14	Drain	tile.																		
	1.89	0.72	0.52	8	4	1.25	0.30	0.47	0.79	1.05	1.26	1.52	3.60	18	1.25	16.00	4.50	3	4.50	55	40	3.50	28,198
G	0.65	0.22	0.20																				
	1.50	0.50	0.50	30	20	1.05	0.45	0.60	0.95	1.00	1.35	1.60	4.10	20	0.90	21.00	3.50	4	6.00	45	30	3.25	34,102
H	0.52	0.25	0.19		47 g.																		
	1.97	0.71	0.47	16s.p.	9 s. p.	1.75	0 54	0.69	0.94	1.30	1.55	1.86	3.50	25	1.50	11.00	3.50	3	6.00	40	40	4.00	35,429
I	0.69	0.25	0.17																				
	3.44	1.26	1.00	26	12	1.50	0.45	0 80	0.90	1.10	1.20	1.40	3.25	1	1.20	18.00	4.25	10	5.25	45	27	3.00	35,559
J	0.75	0.40	0.33																				
	1.50	0.55	0.35	19	9	0.85	0.42	0.72	1.44	1.90	2.56	3.24	5.50	25	0.75	25.00	4.50	4½	3.00	50	45	3.00	44,904
K	3.50	1.15	1.05																				
	9.00	1.15	1.05	115	90	1.25	3.00	3.45	3.70	4.45	No price given.			16	1.50	32.00	.....	3½	40.00	45	.....	6.00	.....

Sewer Pipe.—*Wilmington, Del.*—The following proposals for furnishing terra cotta pipe during the current year were received recently by Mr. T. C. Hatton, engineer in charge of sewers, and the contract was awarded to the Delaware Terra Cotta Co. The bidders were as follows: A, Delaware Terra Cotta Co., Wilmington, Del. (2% discount for 10 days); B, Joseph R. Clausen & Son, Philadelphia, Pa. (agents for Akron pipe); C, Pittsburg Clay Mfg. Co., New Brighton, Pa.; D, McMahon, Porter & Co., New Cumberland, W. Va. The prices are per lin. ft. for pipe and per piece for Y branches:

	A.		B.		C.		D.	
	Pipe.	Ys.	Pipe.	Ys.	Pipe.	Ys.	Pipe.	Ys.
Pipe.	Ys. Cts.	Cts.	Cts.	Cts.	Cts	Cts.	Cts.	Cts.
24-in.	40..97½	243.9	97½	243.9	104	512	140	325.2
20-in.	70..67½	168.8	67½	168.8	78	354	90	225.2
18-in.	73..51	127½	51	127½	59½	267	60	168
15-in.	125..37½	93.9	37½	93.9	43	197	50	125.2
12-in.	225..25½	63.9	25	63 9	29	134	25½	63.9
10-in.	261..19½	48.9	19½	48.9	23	102	19½	48.9
8-in.	125..13½	33.9	13½	33 9	15¾	71	13½	33.9
6-in.	80.. 9	22¼	9	22¼	10½	47	9	22¼
Total.		$6,817		$6,794		$8,528		$8,058

Sewers.—*Dubuque, Ia.*—Contracts for pipe sewers have been awarded by Mr. M. Tschirgi, City Engineer, as follows: M. Lavin, 12-in., 60 cts. per ft.; manholes, $35; flush tanks, $40. D. W. Linehan, 8-in., 60 to 69 cts.; 12-in., 72 cts. per ft.; manholes, $27.50; flush tanks, $30.

Danbury, Conn.—The contract for the outfall sewer has been awarded to Peter Swenny, of Danbury, at $53,950.

Westfield, Mass.—The Selectmen have annulled the contract with John Marsden for laying sewer pipe, noted last week, and have awarded it to Sackett Bros., of Westfield.

Albany, N. Y.—Contracts have been awarded as follows by the Board of Contract: Spring and Dove Sts., Jacob Holler, 15, 12 and 6-in. pipe, 97, 82 and 80 cts. per ft.; 15 and 12 in. Ys., $3.30 and $3.15; manholes, $65; lampholes, $14; basins, $83. Dove St., Jacob Holler, 68 cts. for 10-in. pipe, $2.50 for 10-in. Ys, 12 cts. per ft. for trench. $65 for manholes, $14 for lampholes. Chapel St., P. Murray, $4.49 for brick sewer, $2.25 for 15-in. pipe, $89 for manholes, $75 for basins.

Kearny, N. J.—P. H. Harrison has a contract for pipe sewer, 90 and 60 cts. per ft. for 15 and 10-in., 12 ft. deep; basins, $100; manholes, $30. T. McManus has a contract for 12-in. pipe sewer, 12 ft. deep, at 88 cts. per ft.; manholes, $29; basins, $95.

Street Work.—*Albany, N. Y.*—Contracts for granite block paving have been awarded as follows: Pine St., Jacob Holler, $3.45 per sq. yd. for paving, $1.21 and $1.37 per

PROPOSALS OPEN.

Highways.—*Wheeling, W. Va.*—Macadamizing on various county roads, 3-in. limestone. H. H. Pendleton, Clerk of Ohio Co. Commissioners. April 29.

Street Work.—*Fernbank, O.*—Natural or artificial stone sidewalks. A. S. Hobby, Engineer, W. F. Bailey, Corporation Clerk, 227 Main St., Cincinnati, O. May 4.

Cleveland, O.—Grading, Medina block paving, curbing, etc. C. G. Force, City Engineer. May 14.

Avondale, O.—Brick paving on concrete, curbing, culverts, etc. W. Ellwood Wynne, Corporation Clerk, May 6.

Sewers.—*Athens, Ga.*—About 5,363 ft. earth and 2,380 ft. rock excavation (9 and 3.5 ft. average cut), 4,380 ft. 8-in. straight pipe, 400 8-in Y's, 12 manholes, 4 flush tanks. J. W. Barnett, City Engineer. May 14.

Sheboygan, Wis.—Brick, 30, 36 and 48-in.; pipe, 10, 12 and 15-in.; 36 manholes, 25 basins. Board of Public Works. May 4.

Piers and Jetty—Ice piers in the Ohio River. Col., Wm. E. Merrill, U. S. Engineer Office, Cincinnati, O. May 15.

Rock, brush fascines, and poles, for jetty at entrance to Coos Bay. Capt. T. W. Symons, U. S. Engineer Office Portland, Ore. May 5.

Dredging.—In Petaluma Creek. Major W. H. Heuer, U. S. Engineer Office, San Francisco, Cal. May 16.

Bridge.—*Washington, D. C.*—Superstructure of highway bridge in National Zoological Park. S. P. Langley, Secretary, Smithsonian Institute. April 30.

Brick and Sand—*Albany, N. Y.*—For furnishing 2,000,000 brick and 1,200 cu. yds. sand. I. G. Perry, Capitol Commissioner. April 30.

MANUFACTURING AND TECHNICAL.

Locomotives.—H. K. Porter & Co., of Pittsburg, Pa., have built a compressed air motor for a coal mine; cylinders 8 × 14 ins., 24-in. driving wheels; can run ¾-mile with one charge, hauling 50 tons up grades of 2 and 3%; the tanks are 33 ins. diameter and carry 350 lbs. pressure. The Cooke Locomotive Works, of Paterson N. J., have an order for 5 passenger engines for the New Jersey Central. The Rhode Island Locomotive Works, of Providence, R. I., have orders for 4 mogul engines for the Maine Central, and are building several six-wheel switch engines.

Cars.—The Missouri Car Works, of St. Louis, Mo., have an order for 1,000 coal cars for the Cleveland, Cincinnati, Chicago & St. Louis. The Gilbert Car Mfg. Co., of Troy, N. Y., has built 8 vestibule cars for the Consolidated St. Ry., of Syracuse, N. Y., 26 ft. long, 18 ft. body, 30 passengers. The Elliott Car Works, of Gadsden, Ala.

The Buda Foundry & Mfg. Co. has removed to new works at Harvey, Ill., where it will manufacture dump, mine and hand cars, frogs and switches, etc.

Companies.—Schultz Bridge & Iron Co., of Pittsburgh, Pa.; incorporators, H. W. Oliver, Wm. R. Thompson and T. S. Bigelow. Chicago Water & Weather Proof Paint Co., of Chicago, Ill.; incorporators, John H. Baker, W. F. Reynolds and Wm. McEndow; capital stock, $25,000. Cold Rolled Steel Co., of Pittsburg, Pa.; incorporators, W. H. Nimic, H. H. Jack and L. B. Shoemaker. Cumberland & Potomac Cement Co., of Cumberland, Md.; incorporators, A. Hixson and A. B. Caldwell, of Philadelphia; capital stock, $25,000. Carlton-Johnson Railway Signal Co., of Atlanta, Ga.; incorporators, Virgil Powers, J. A. Carlton and H. L. Johnson; capital stock, $100,000.

Metal Market Prices.—*Rails.*—New York: $30.75 to $31; old rails, $24.50 for iron and $17 for steel. Pittsburg: $30; old rails, $24 to $24.25 for iron and $17 to $17.50 for steel. Chicago: $31; old rails, $23 to $24 for iron and $14.50 to $16 for steel.

Track Materials.—New York: steel angle bars, 1.75 to 1.8 cts.; spikes, $1.9 to $1.95; track bolts, 2.75 cts. with square, and 2.9 cts. with hexagon nuts. Pittsburg: splice bars, 1.9 to 2 cts. for iron or steel; iron or steel spikes, 2.05 cts.; iron track bolts, 2.8 cts. with square, and 2.9 cts. with hexagon nuts. Chicago: splice bars, 1.85 to 1.9 cts. for iron, 2 to 2.05 for steel; spikes, 2 cts.; track bolts, 2.85 cts. with hexagon nuts.

Foundry Pig Iron.—New York: $14 to $16. Pittsburg: $14 to $16.50. Chicago: $14.50 to $16.

Pipe.—Cast iron, $25 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 57½ and 50 per cent. on black and galvanized butt-welded; 67½ and 55 on black and galvanized lap-welded. Casing, 55 per cent.

Lead.—New York: 4.1 to 4.15 cts.; Chicago: 3.75 to 3.95 cts.; St. Louis: 4 to 4.05 cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 1.95 to 2.1 cts.; tees, 2.45 to 2.75 cts.; sheared iron plates, 2 to 2.25 cts.; steel plates, 2 to 2.15 cts. for tank, 2.3 to 2.6 cts. for shell, 2.5 to 2.7 cts. for flange, 3.75 to 4.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2.05 cts.; tees, 2.65 cts.; universal iron mill plates, 2.1 cts.; sheared steel bridge plates, 2.3 cts.; refined bars, 1.85 to 1.9 cts.; steel plates, 2.15 cts. for tank, 2.5 cts. for shell, 2.7 cts. for flange, 4.25 to 4.5 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.25 to 2.5 cts.; tees, 2.7 to 2.85 cts.; universal plates, 2.3 to 2.4 cts.; sheared plates, 2.5 to 2.6 cts. for iron and 2.6 to 2.7 cts. for steel; steel plates, 2.6 to 2.7 cts. for tank, 3.25 cts. for shell, 3.5 cts. for flange, 4.25 to 5.5 cts. for firebox; boiler rivets, 4 to 4.25 cts.